SECTION 2.0

WESTERN RANGE

RANGE SAFETY PROGRAM

2.1 INTRODUCTION

Section 2.0 describes the Safety Organization and the Range Safety Program for the Western Range (WR) and provides an overview of the features that comprise this program. The Range Safety Program has the authority and responsibility for both ground and flight activities such as test, checkout, assembly, servicing, and launch of launch vehicles and payloads to orbit insertion or earth impact. The safety organization and responsibilities, Western Range safety policy, and Western Range safety program are the major topics discussed in this section.

2.2 SAFETY ORGANIZATION AND RESPONSIBILITIES

A description of the range organization and responsibilities of the Chief of Safety is provided in Section 1. The following is a more detailed discussion of the functional safety responsibilities of the four primary Range Safety sections (SEG, SES, SEO, and SEY) and their lower elements that are responsible to the Chief of Safety (see Figure 2-1).

2.2.1 Ground Safety (30 SW/SEG)

Ground Safety is responsible for the following:

- Reviewing, coordinating, and approving procedures for prelaunch processing;
- Monitoring selected activities at the launch head;
- Providing prelaunch and countdown Launch Support Teams;
- Providing emergency response support and/or assistance in the event of failures and mishaps during ground operations;
- Advising the on-site commander on disaster preparedness and responsiveness;

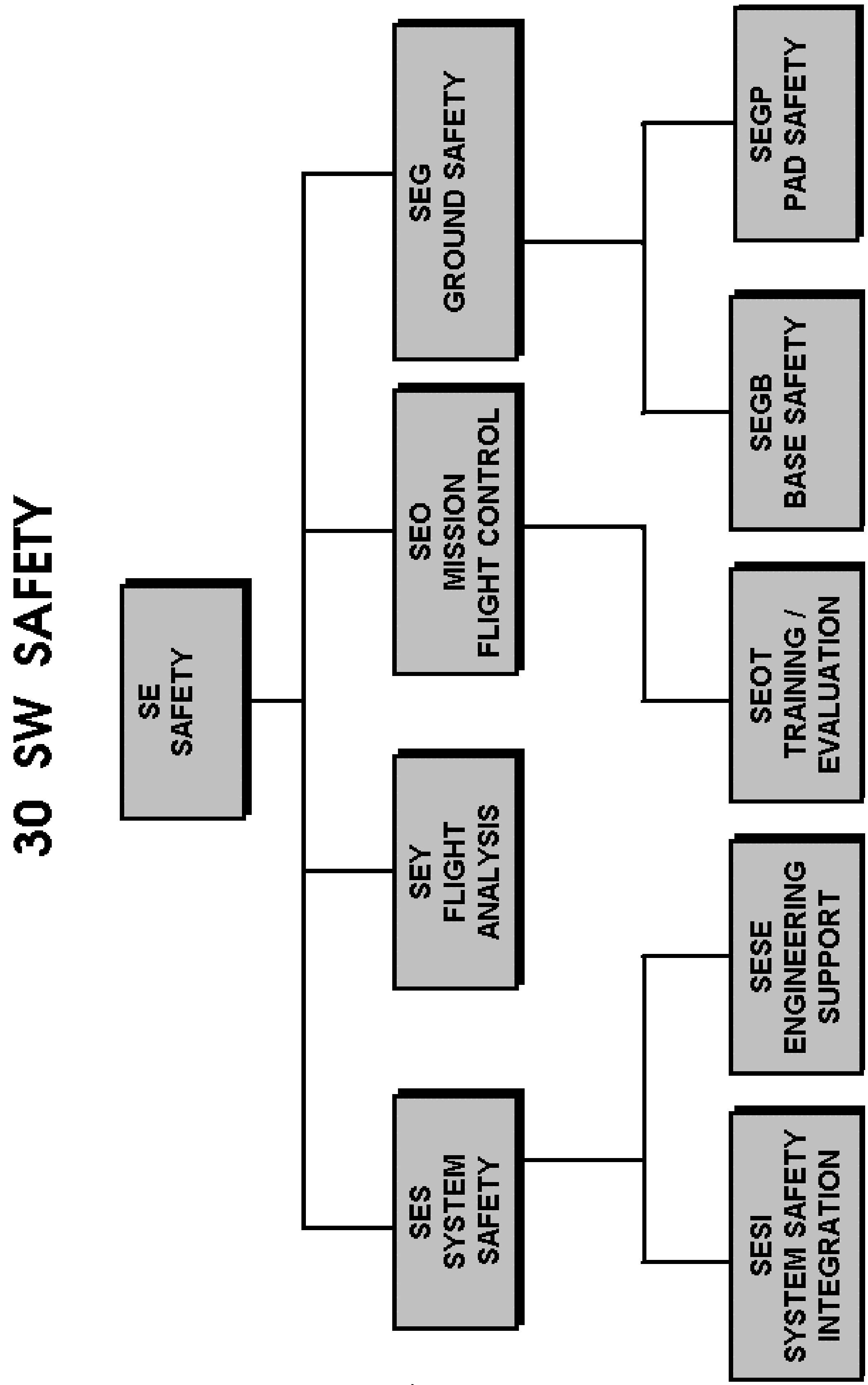


Figure 2 - 1: 30th SW Safety Organization

- Oversight of motor vehicle safety;
- Accident Prevention;
- Oversight of housekeeping functions;
- Oversight of Base Safety Programs e.g. driver's training and certification, fire prevention and safety.

2.2.2 Mission Flight Control (30 SW/SEO)

Mission Flight Control is responsible for protecting the general public, the launch area, and US and foreign land masses from errant launch vehicle flight. In conjunction with Flight Analysis (SEY) and Systems Safety (SES), Mission Flight Control uses flight safety analysis and systems safety engineering products to develop and implement real-time mission rules and flight termination criteria to control errant launch vehicle flight from launch to impact of vehicles with suborbital trajectories or to orbital insertion for space launch vehicles.

2.2.3 Systems Safety (30 SW/SES)

Systems Safety is responsible for ensuring that public, launch area, and launch complex safety and resource protection are adequately provided by and for all programs using the range. Responsibilities include:

- Developing safety critical design and operating criteria and requirements;
- Reviewing and approving documentation, design, and testing of airborne range safety systems;
- Developing, enforcing, reviewing, and approving engineering documentation, design, and testing of hazardous launch vehicle, payload, ground support equipment (GSE), and facility systems;
- Reviewing, approving, monitoring, and classifying (as public launch area or launch complex safety) hazardous and safety-critical operations;
- Providing safety engineering and developing processes and procedures to mitigate risks involved in prelaunch and launch operations for both the general public and the launch area.

2.2.4 Flight Analysis (30 SW/SEY)

Flight Analysis is responsible for providing pubic safety by developing criteria for the control of errant vehicle flight. Responsibilities include:

- Approving all launch vehicle and payload flight plans;

- Determining the need for Flight Termination Systems (FTS);Establishing mission rules in conjunction with 30 SW/SEO and range users;

- Determining criteria for flight termination action and develop requirements for Missile Flight Control Officer (MFCO) displays;

- Defining safety clearance zones and providing advice for the control of access to safety clearance zones within the confines of the launch head;

- Assessing risks to the general public, launch area, and launch complex personnel and property;

- Identifying and evaluating risk reduction actions such as evacuation, sheltering, and safety holds for suitable meteorological conditions;

- Developing mathematical models to increase the effectiveness of errant vehicle control while minimizing restrictions on launch vehicle flight;

- In conjunction with Mission Flight Control, ensuring that Mission Flight Control Officers are trained to perform errant launch vehicle control;

- Determining on-orbit collision avoidance (COLA) requirements for manned vehicles or vehicles capable of being manned.

Each of the Safety Office sections is responsible for initiating, establishing, and implementing range user interface processes to ensure that the requirements of EWR 127-1, Range Safety Requirements, are met. Note: EWR 127-1 is a regulation, jointly written by Eastern Range and the Western Range, that contains a common set of requirements for range users.

2.2.5 30 SW Supporting Organizations

The 30 SW/SE interfaces with other 30 SW organizations who have the responsibility of supporting the Range Safety effort.

2.2.5.1 Commander, 30 Operations Group (30 OG)

The 30 OG Commander is responsible for providing Range Safety with the instrumentation, computers, communications, command transmitter systems, and Range Safety display systems necessary to carry out prelaunch and flight safety functions. Range Safety provides the 30 OG with mandatory and required support requirements for each launch activity, and the 30 OG ensures that these operational requirements are met.

2.2.5.2 Commander, 30 Logistics Group (30 LG)

The 30 LG Commander ensures that all required instrumentation, computers, communications, command systems, and Range Safety display systems necessary for Range Safety to carry out its functions meet Range Safety requirements, perform to the prescribed level of reliability, and are designed in accordance with Range Safety specifications and requirements.

2.2.5.3 Commander, 30 Support Group (30 SPTG)

The 30 SPTG Commander is responsible for determining, coordinating, and enforcing fire safety, environmental engineering, and explosive ordnance disposal requirements. The Fire Department, Environmental Engineering and Explosive Ordnance Disposal are responsible for establishing and implementing their programs in coordination with the Safety Office.

2.2.5.4 Commander, 30 Medical Group (30 MDG)

The 30 MDG Commander is responsible for determining, coordinating, and enforcing medical, biological, and radiological health requirements. The Radiation Protection Office and Bio-environmental Engineering are responsible for establishing and implementing their programs in coordination with the Safety Office. Examples of areas that are coordinated with the Safety Office include, but are not limited to, toxic exposure criteria, sheltering requirements for toxic exposure, and laser safety.

2.2.5.5 Other

Other WR agencies provide the following computational, plotting, and reproduction services for flight control planning and preflight requirements:

- Operate computing and plotting equipment;
- Perform analytical studies, formulate mathematical models, and develop computer programs to meet specifications established by SEY;
- Process magnetic tapes supplied by the range customer and provide computer listings and trajectory output files;
- Compute random and systematic errors for the instrumentation systems used for flight control. Errors are converted to appropriate statistical parameters to evaluate the magnitude of real-time impact predictor errors throughout thrusting flight;
- Calculate acquisition times, look angle, aspect angle, and signal strength to arrive at tracking, telemetry, and command destruct expected coverage estimates;
- Maintain the real-time impact prediction program and other related real-time and prelaunch programs. Evaluate time delays in the real-time program and in associated instrumentation systems;

- Provide miscellaneous reproduction and photographic services and prepare viewgraphs and briefing slides as required.

2.3 WESTERN RANGE SAFETY POLICY

It is the policy of the range to ensure that the risk to the public, to personnel in the launch area, and to national resources is minimized to the greatest degree possible. This policy is implemented by employing risk mitigation techniques.

2.3.1 Public Exposure

The WR acceptable risk guidance for public exposure to launch operations is shown in Figure 2-2. In addition, an impact probability (P_i) of 1×10^{-8} is the threshold level for aircraft and a P_i of 1×10^{-5} is the threshold level for ships. These numbers are used as management decision points, not hard limits. The range user must endeavor to maintain the lowest risk level possible, consistent with mission requirements. Individual hazardous activities may exceed guidance criteria depending on national need, mission requirements, or use of risk mitigation techniques. The WR strives to ensure that the risk to the general public and foreign countries from range operations does not exceed the risk to the general public from all natural causes and meets the guidance established in the legislative history of Public Law 60. To that end, the range will:

- Control all prelaunch and launch operations conducted on the range to ensure that the hazards associated with propellants, ordnance, radioactive material, and other hazardous systems do not expose the general public to risks greater than those considered acceptable by public law and state regulations;

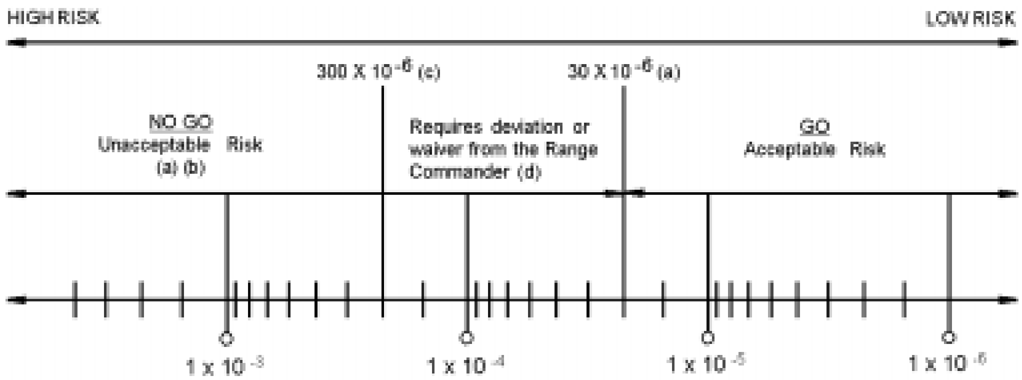
- Conduct and oversee launch and flight operations in a manner to ensure the risks to the general public, foreign countries, and the launch areas do not exceed acceptable limits consistent with mission and national needs;

- Limit land overflight in the downrange area to cases where the total public risk in that area does not exceed 30×10^{-6} or the individual public risk 1×10^{-6};

- Verify that all space vehicles and missiles launched from or onto the WR have a positive, range-approved method of controlling errant vehicle flight. This control must meet the objective of minimizing risks to the general public and foreign countries.

2.3.2 Control Systems

Normally, control systems on launch vehicles using the WR will consist of an FTS that meets the requirements of EWR 127-1. A thrust termination system may be considered as an alternative to an FTS, however, quantification of risks must be determined. In addition, the alternative



NOTES:

(a) Risk is defined in terms of casualty expectation. A casualty is defined as a severe injury (or worse).
(b) Unacceptable risk to the general public; does not meet the intent of PL60 or DODD 3200.11.
(c) The upper bound for essential launch area personnel is based on one casualty per 100 years with a launch rate of 33 per year.
(d) Cumulative risks at this level from multiple launches may drive the annual risk to be unacceptable.
(e) The upper bound for GO is based on an equivalent to an average of one casualty per 1000 years with launches at the rate of 33 per year and assuming a population of 250,000 in the area of the launch facility.

("From a Safety Standpoint, they (missiles) will be no more dangerous than conventional airplanes flying overhead." Legislative History, 81st Congress, pg. 1235)

Figure 2 - 2: Risk Level Guidance for Public Exposure

thrust termination concept and design must be approved by the WR Commander.

- Each launch system must have a hold-fire capability that prevents launch in the event of an unsafe range condition, loss of critical Range Safety systems, or violation of mandatory Range Safety criteria. Safety holds are initiated to prevent the start of an operation, or to stop an operation that is already underway, if it violates public safety or launch commit criteria. These holds may be called if safety criteria are violated or cannot be ensured when personnel or resources are jeopardized. Safety holds may be initiated by the Mission Flight Control Officers, Operations Safety Manager, range user, or any responsible supervisor in charge of an operation.

2.3.3 Clearance Zones

Safety clearance zones and procedures to protect the public on land, on the sea, and in the air are established and controlled for each launch vehicle using the WR (see Figure 2-3).

- No space vehicle, missile, payload, reentry vehicle, or jettisoned vehicle part is allowed to intentionally impact on land. Flight paths and trajectories must be designed so that normal impact dispersion areas do not encompass land. Safety margins should be used to avoid overly restrictive flight termination (destruct) limits;

- Errant launch vehicles may be allowed to fly to obtain valuable data, but will not be allowed to present an unacceptable risk to the public.

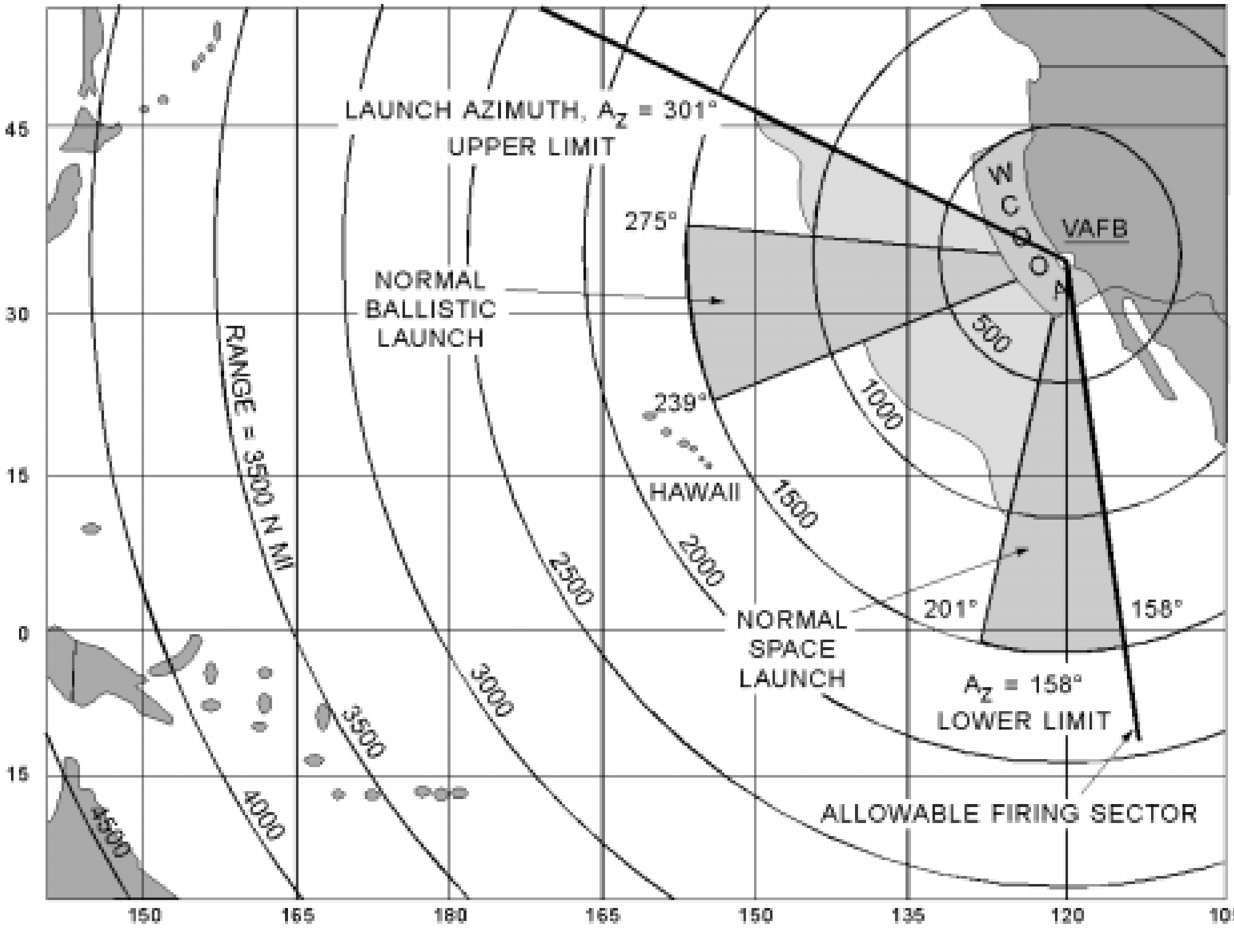


Figure 2 - 3: Typical WR Launch Sectors

2.3.4 Safety Approvals

In order to operate on, use, or launch from or into the WR, specific mandatory safety approvals must be obtained to show compliance with the requirements of the WR (see Figure 2-4). In addition, commercial launch operators must have an approved Federal Aviation Authority (FAA) license.

2.3.4.1 Wing Commander Approvals

The following safety approvals require the signature of the WR Commander:

- Range Safety mission flight rules, including errant vehicle control criteria for all launch vehicles;
- Range Safety launch commit criteria for all launch vehicles;

- The launch of vehicles containing explosive warheads;
- The launch of nuclear payloads;
- High risk noncompliance issues affecting public safety.

2.3.4.2 Chief of Safety Approvals

The following safety approvals may be signed by the Chief of Safety or his designated representative:

- Noncompliance issues not referred to the Wing Commander(par. 2.4.4.1). The majority of deviations and waivers fit into this category;
- System Safety Program Plan (par. 2.4.4.4);
- Safety Training and Certification Plan (par. 2.4.7);
- Preliminary and Final Flight Plan Approvals (par. 2.4.2);
- Aircraft and Ship Intended Support Plans (par. 2.4.4.4);
- Directed Energy Plans (par. 2.4.4.4);
- Missile System Prelaunch Safety Package (par. 2.4.1.1);
- Airborne Range Safety System Report (par. 2.4.4.4);
- Hazardous and Safety Critical Procedures (par. 2.4.4.4);
- Facilities Safety Data Package (par. 2.4.4.4);
- Range Safety Launch Operations Approval Letter (par. 2.4.4.4);
- Final Range Safety Approval for Launch (par. 2.4.4.4);
- Range Safety instrumentation, tracking data, and display requirements for all launch vehicles (par. 2.4.4.4).

2.3.4.3 Launch Complex Safety Approvals Authorized by Control Authorities

The single commercial launch operator, full-time government tenant organization, or USAF squadron/detachment commander, as the control authority, has the responsibility for launch complex safety and will exercise the function in accordance with Range Safety Training and Certification

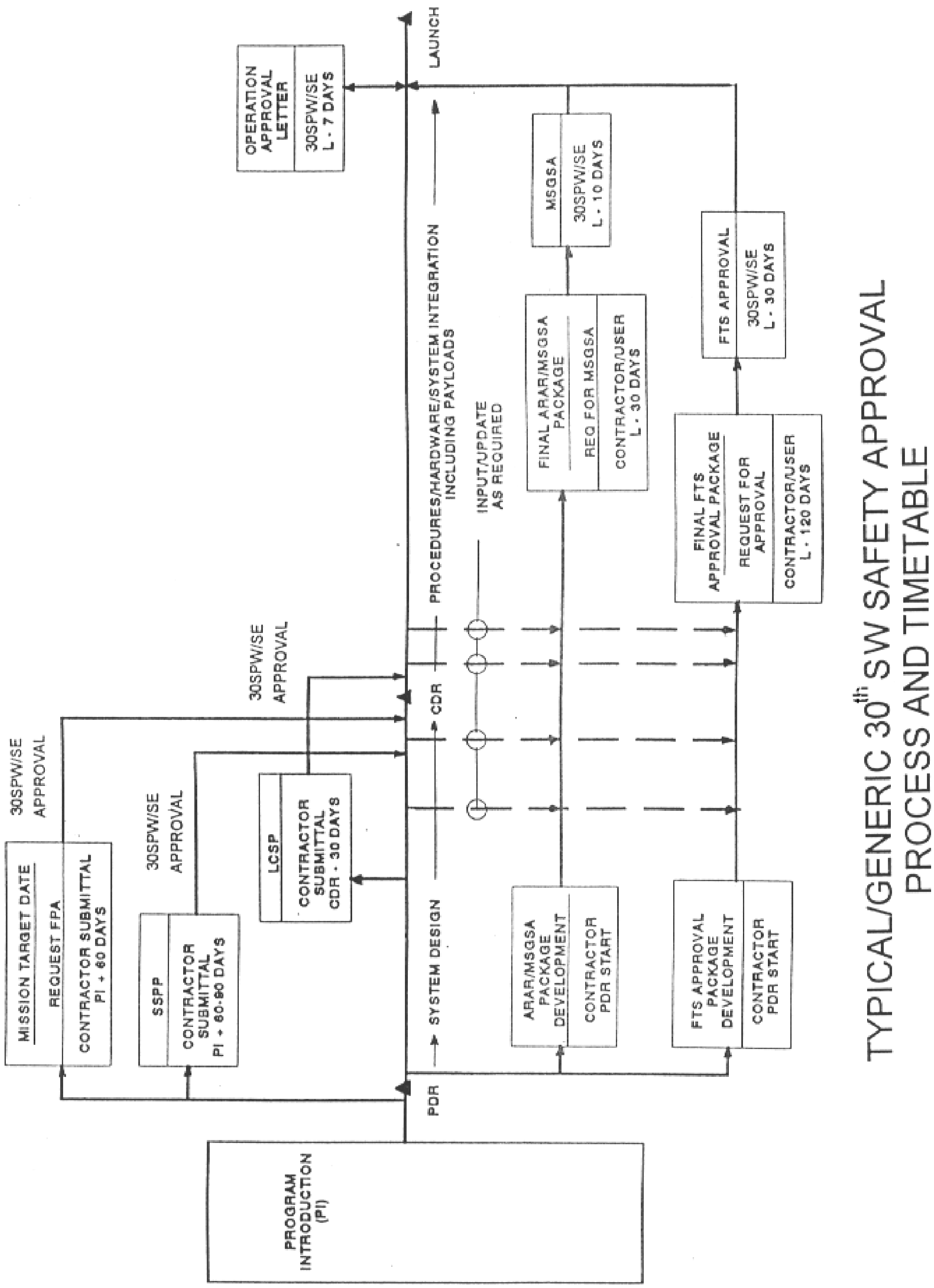


Figure 2 - 4: Safety Approval Process

requirements. The control authority has the option of delegating this responsibility to the Chief of Safety. In all cases, the Chief of Safety will review and approve all hazardous operating procedures and any other procedures that Range Safety deems necessary to insure such operations do not pose or create a hazardous condition.

2.3.4.4 Safety Approvals Authorized by the DOD Explosive Safety Board

Explosive site plans require the signature of a member of the DOD Explosive Safety Board. For guidance in determining the process necessary to obtain approval, the commercial launch customer should contact the 30 SW Safety Office.

2.3.4.5 EWR 127-1 Tailoring

EWR 127-1 tailoring is approved at the working level within the safety organization. Issues that arise during the tailoring process which violate policy or generate significant safety hazards are noncompliance issues which may result in requests for deviations or waivers. Such deviations or waivers require senior management approval.

2.4 THE WESTERN RANGE SAFETY PROGRAM

The national range system, established by Public Law 60, was originally sited-based on two primary concerns: location and public safety. Thus, Range Safety, in the context of national range activities, is rooted in PL 60.

To provide for the public safety, the range, using a Range Safety Program, ensures that the launch and flight of launch vehicles and payloads present no greater risk to the general public than that imposed by the overflight of conventional aircraft. In addition to public protection, safety on a national range includes launch area safety, launch complex safety, and the protection of national resources.

2.4.1 Missile System Ground Safety

All flight hardware, ground support equipment, facilities, and ground operations associated with activities on the WR that have the potential to present a hazard to the general public require safety approval. This approval is given when Range Safety has received, reviewed, and approved the contents of the Missile System Prelaunch Safety Package (MSPSP).

2.4.1.1 Missile System Prelaunch Safety Package

The MSPSP is the data package that describes, in detail, all hazardous and safety critical systems/subsystems and their interfaces in vehicles, payloads, ground support equipment, facilities, and launch pads. In addition, the MSPSP provides verification of compliance with EWR 127-1. The MSPSP must be approved by Range Safety prior to the arrival of any launch vehicle/payload element, activation of a hazardous processing facility, or commencement of any hazardous operation on the WR. Supporting documentation is requested as required by Range Safety. The following is typical of the information presented in the MSPSP.

2.4.1.1.1 Introduction

This section contains brief statements of the scope and purpose of the MSPSP, the type of launch vehicle, payload, and mission, a brief description of changes from previous vehicles/payloads, and other general information thought to be useful, such as sketches of the vehicle, payload, or facility.

2.4.1.1.2 General Description of the Launch Vehicle, Payload, and Facilities

This section provides an overview of the system as a prologue to the subsystem descriptions. It also includes information as to physical dimensions and weight, nomenclature of major subsystems, types of motors and propellants to be used, and sketches or photographs of the vehicle, payload, and/or facility. A synopsis is provided for each hazardous subsystem.

2.4.1.1.3 Flight Hardware and Ground Support Equipment Subsystem Description and Hazards

This section describes each of the hazardous subsystems by giving an overview of each system, and then describing each item in terms of nomenclature, function, location (using sketches), operations (using schematics and /or flow charts), design parameters, testing, operating parameters, and hazard analyses. Supporting data is included or summarized and referenced, as appropriate, upon request. Specific data requirements for hazardous subsystems are contained in EWR 127-1. However, additional data may be required to substantiate the safety of the system. Tables, matrices, and sketches are required to provide a description of component data. The MSPSP must have a subsection for each of the following major subsystems:

- Structures/Mechanisms;
- Material Handling Equipment;
- Pressure, Propellant, and Propulsion Subsystems;
- Electrical and Electronic Subsystems;
- Ordnance Subsystems;
- Non-Ionizing Radiation Subsystems;
- Ionizing Radiation Subsystems;
- Acoustical Subsystems;
- Hazardous Materials;
- Computing Systems Data;
- Operations Safety Console;
- Vehicle Data;
- Seismic Data.

The Ground Support Equipment (including government-furnished and contractor-furnished equipment) section must be organized by hazardous subsystem and must account for all GSE. A portion of the GSE section must be dedicated to personnel protective equipment.

Subsequent sections may be added to provide any other data pertinent to the safety of prelaunch and launch operations. Range Safety will request additional information, as required, in order to conduct a thorough assessment of the system.

2.4.1.1.4 Ground Operations

The following information is generally included in the MSPSP, but may be submitted separately as part of a Launch Base Test Plan or Ground Operations Plan and referenced in the MSPSP. Separate submittals must be provided with each MSPSP and must, as a minimum, identify the ground processing flow, including all hazardous operations. Thus far the WR does not do off-site processing.

- All procedures (hazardous and non-hazardous) that are to be used at the range must be listed by title and numerical designation with an indication as to which have been designated as hazardous or related to flight termination system operations. Procedure descriptions must include a separate listing of tasks so that hazardous tasks within each procedure can be identified.

- A task summary of each procedure must be provided. This must include each separate task, responsible agency, objective, initial/final configuration, equipment/support required, description, hazards and precautions, and figures where they add to the description of the activity.

- A flow chart must be included that indicates relative expected time sequences and locations of each individual procedure/task. The purpose of this is to evaluate simultaneous operations, hazards, and controls, and to ensure changes in the hazardous configuration of the facilities and hardware are identified. This flow chart must include an identifier for each procedure. The identifier contains procedure number, hazardous or non-hazardous designation, and task summary number.

- Provisions for emergency and abort/recycle situations must be identified.

2.4.1.1.5 Compliance Checklist

A checklist of all data submittal, design, analysis, and test requirements in EWR 127-1 must be provided in the MSPSP. The checklist must include the following for each requirement:

- criteria/requirement;

- system;

- compliance;

- non compliance;

- not applicable;
- resolution;
- reference;
- copies of all Range Safety approved non-compliance's.

2.4.1.1.6 Changes to the MSPSP

Changes must be summarized in the MSPSP change section and highlighted throughout the document using change bars or similar means of identification.

2.4.1.2 System Modification

Once hazardous systems have been approved, their configuration, components, and interfaces with other systems must not be modified without Range Safety concurrence. Updates to the MSPSP must be provided to maintain accuracy with current system design.

2.4.2 Flight Safety

This section covers the flight safety requirements that the range user must meet before conducting a mission or flight operation on the Western Range. These requirements are for trajectory data and system flight characteristics for ballistic missiles and space vehicles. It also covers the data requirements and procedures for obtaining approval for mission flight plans. Using the data submitted by the range user, Range Safety analyzes each mission from a flight safety standpoint and prepares flight safety criteria to ensure safe conduct of the mission.

2.4.2.1 Flight Plan Approval (FPA)

Approval of a proposed flight plan or mission by the Chief of Safety, or a designated representative (SEY), is a necessary prerequisite for flight operations and tests, and indicates the hazards associated with the launch fall within an acceptable level. The range user should initiate flight plan approval action at the earliest practical date to establish that the proposed mission, or trajectory, and proposed overflight conditions are acceptable from a safety standpoint. Ideally, flight plan approval for each mission should be requested during the initial planning or conceptual phase. For new programs, a request should accompany the Program Introduction or, in any event, be submitted immediately after the range has replied to the Program Introduction with a Statement of Capability.

The flight plan approval request addresses the applicable requirements of EWR 127-1 to the greatest extent possible. In many cases, the information provided suffices for evaluation of the flight plan. In other cases, where the proposed plan exceeds normally accepted limits, additional data will be required. Range Safety will respond in writing to the flight plan approval request by issuing a letter of approval or disapproval, by requesting that a change in the proposed plan be made or investigated, or by delineating the additional data required before a decision can be made.

When the flight plan is approved, the response letter will specify the conditions of approval pertaining to such things as flight azimuth limits (varies by program), trajectory shaping, wind restrictions, locations of impact areas; overflight areas, times, and restrictions; times of discrete events, and number of vehicles or missions for which the approval applies. The approval will be final as long as the mission remains within the stated conditions. A Flight Plan Approval is published for each flight.

2.4.2.2 Flight Plan Approval Procedures

The information that should be submitted with the FPA request is specified in EWR 127-1. If sufficient data are not available to meet the requirements, the range user should meet with SEY to discuss the program and to provide all available information. SEY will review the available data and advise the range user of additional data or hazard analyses that are required. At this time in the program development, the design of the vehicle systems may not be fixed. SEY will make the range user aware of the flight safety requirements so that the design of the safety systems and other systems will meet the requirements of EWR 127-1.

It is extremely important, and ultimately cost effective, that the range user provide all data requirements needed by SEY prior to the final design of any systems that affect safety. If the SEY processing takes two months, the range user’s data must be submitted two months before systems are finalized or two months before the range user requires FPA, whichever is earlier.

2.4.2.3 Flight Plan Approval Letter

The range user is advised, as soon as possible, of the acceptability of the vehicle flight plan and safety systems. This information will be communicated by the most expeditious method (briefings, telephone conferences, and/or letters). This will allow the commercial launch operator to expedite modifications or waiver requests to comply with safety requirements. A formal FPA letter is prepared by SEY that sets forth the range safety position on the range user’s request for FPA. The FPA letter is signed by the Chief of Safety or his designated representative and contains the following information, as applicable:

- The acceptability of the command control system to effectively provide control of a malfunctioning launch vehicle;

- The adequacy of a command control system throughout powered flight in accordance with EWR 127-1;

- The adequacy of tracking systems to meet the requirements of EWR 127-1;

- An assessment of overflight casualty expectancies associated with the planned launch and a comparison of these hazards to previously acceptable casualty expectancies for similar flights;

- Any restraints on the launch, such as flight azimuth or launch area wind conditions or launch overflight conditions and restrictions;

- Description of waivers that have been requested by the range user and their status;

- A statement that final trajectory data for the launch must be provided in accordance with EWR 127-1 even though the FPA is granted;

- Any other information the SEY analyst believes is qualifying to the FPA.

2.4.2.4 Flight Safety Restrictions

No missile, space vehicle, payload, reentry vehicle, or jettisoned component will be intentionally impacted on land. Proposed flights must be planned and trajectories shaped so that normal impact dispersion areas for such items, even for vehicle trajectories which include downrange land overflight, do not encompass land. A sufficient safety margin should be used to avoid overly restrictive flight termination lines. If a stage contains multiple-burn engines, the impact dispersion area corresponding to any planned cutoff before orbital insertion must be entirely over water. Critical events (such as arming of engine cutoff circuits and sending of backup engine cutoff commands) must be sequenced to occur when the impact dispersion areas are entirely over water.

2.4.2.5 Flight Termination Systems

A vehicle's need for a flight termination system will be determined on a case by case basis by 30 SW/SEY. When an FTS is necessary it must meet the requirements defined in EWR 127-1. This system must be redundant and capable of termination of thrust on any or all stages at any time in flight, up to the point of final impact or orbital insertion. The overall system reliability goal of the flight termination system is a minimum of 0.9981 at 95% confidence. The airborne FTS reliability goal shall be a minimum of 0.999 at the 95% confidence level. The ground FTS shall have a reliability of 0.999 at the 95% confidence level for a four-hour duration. This reliability goal is satisfied by using the design approach and testing requirements described in EWR 127-1. Small rockets whose impacts can be adequately controlled by pre-launch restrictions are excluded from the requirement for an FTS.

2.4.2.6 Flight Safety Analysis

SEY uses the data submitted in the Preliminary and Final Flight Analysis Data Packages to prepare safety criteria designed to protect critical areas from the potential hazards of an errant vehicle. Critical areas are generally populated, but can also include critical facilities and launch vehicles. Unpopulated land masses, boats, ships, and aircraft routes can also be considered critical depending on the launch vehicle and its trajectory. Sets of criteria are developed for each launch for presentation on the MFCO console. The Range Safety displays show real-time plots of Instantaneous Impact Point (IIP) data plotted over background displays. The background contains nominal and dispersed trajectories that define the limits of a normally performing vehicle and IIP destruct lines. A normally performing vehicle is one that does not exceed three-sigma performance limits. Any deviation outside these limits indicates that the vehicle is not performing within normal limits, though not necessarily posing a threat to populated areas. The flight termination criteria ensure that MFCO destruct action will not be taken for a vehicle performing normally within three-sigma limits. There are no destruct lines crossing South America or the African Coast (see Figure 1-35). Appropriate destruct action must be taken before the land crossing starts.

After preliminary flight plan approval has been granted, the range user must submit a Final Flight Analysis Data Package that provides detailed trajectory and vehicle performance data, in specified formats, in accordance with lead times established in Table 2-1. If the deadlines for trajectory and vehicle performance data are not met, the Flight Analysis Section may be unable to prepare the necessary safety criteria in time to support a proposed flight test or operation. In this event, the test or operation will not be conducted until adequate safety preparations can be made.

2.4.2.6.1 Launch Area Risk Analysis (LARA)

The WR uses the Launch Area Risk Analysis (LARA) computer program to compute impact probability (P_i) and casualty expectation(E_c) for predetermined locations with a specified population, such as launch pad facilities, industrial area facilities, oil rigs, and population centers. It is used as a prelaunch tool in establishing hazard limit values associated with the

Table 2 - 1: Lead Times (Calendar Year)

Vehicle/Missile	Lead Time Before Launch (Calendar Days)
Ballistic Missile:	
*PFPA (New/Existing)	2Y/1Y
**FFPA (New/Existing)	120D/60D
Space Vehicle:	
PFPA (New/Existing)	2Y/1Y
FFPA (New/Existing)	120D/60D
Space Vehicle: Variable Flight Azimuth	
PFPA (New/Existing)	2Y/1Y
FFPA (New/Existing)	18M/6M
Project Firing Tables	9D
Cruise Missile/Remotely Piloted Vehicle:	
PFPA (New/Existing)	2Y/1Y
FFPA (New/Existing)	120D/60D
Small Unguided Rocket:	
PFPA (New/Existing)	2Y/1Y
FFPA (New/Existing)	120D/60D
Aerostat/Balloon:	
PFPA (New/Existing)	2Y/1Y
FFPA (New/Existing)	120D/60D
Projectile, Torpedo, Air-Dropped Body or Device:	
PFPA (New/Existing)	2Y/1Y
FFPA (New/Existing)	120D/60D
Ship and Aircraft ISP:	20D
Directed Energy Systems (New/Existing)	1Y/30D
Large Nuclear Systems	See EWR 127-1, par.. 2.4.4.3
*PFPA - Preliminary Flight Plan Approval	
**FFPA - Final Flight Plan Approval	

planned mission. Inputs to the program include launch pad coordinates, azimuth, population figures, wind speed and direction, vehicle failure probabilities, fragment data, turn rates, destruct line location, nominal trajectory, three-sigma left and right data, MFCO reaction time, failure times, destruct velocities imparted to fragments, stage burnout, and jettison times. The final output of LARA is the impact probability from lethal and non-lethal fragments and casualty expectation associated with death or near fatal injury.

The LARA debris plot program is used to plot the results of a LARA analysis on Vandenberg Air Force Base area maps. The plots contain the launch azimuth, impact limit line, one of six different destruct trajectories, and the locus of debris impacts as a function of time from launch. Different loci are plotted for various ballistic coefficients and winds.

The real-time debris footprint (see Figure 2-5) is displayed on the Range Safety Display System and viewed by the MFCO during flight. Various types of information are available to the MFCOs in order for them to make decisions regarding the public risk from a launch vehicle. Time from liftoff, vehicle range, acceleration, and velocity are displayed in the upper left of the screen. Mission-discrete information, such as Minimum Time to Endanger (MTE) and destruct, appear in the left center portion of the screen. Tracking information appears in the lower left portion of the screen as well as the sensor table (not shown) located at the bottom of the screen.

NOTE: Minimum Time to Endanger is defined as the first time that a missile has sufficient time to hazard an area outside of the impact limit line. If no sensor has acquired track of the launch vehicle by the MTE, the MFCO is authorized to terminate the flight.

2.4.2.6.2 The BLAST Program

The BLAST Overpressure Wave Propagation analysis program is run for vehicles with stages or motors with highly energetic propellants (class 1.1). Inadvertent detonation of these highly energetic propellants could yield the equivalence of many tons of TNT. Inputs to the program include the point of detonation, the focusing of the overpressure due to terrain, and temperature and wind velocity to 20K feet. This analysis yields results which are used to develop GO/NO GO criteria expressed as estimated casualty expectation (E_c) as a result of window breakage for the event.

Data is presented in graphic form with raw meteorological data plotted against GO and NO GO criteria or as breakage and casualty figures separated into predicted breakage, predicted injury percentages and predicted casualties (given that the event occurs). From a study of this data the MFCO makes his recommendation to the Chief of Safety and the 30 SW Commander.

2.4.2.6.3 Rocket Exhaust Effluent Diffusion Model (REEDM)

The Rocket Exhaust Effluent Diffusion Model (REEDM) is run on a laptop PC in the MFCC. The results are interpreted and presented to the Chief of Safety and the 30 SW Commander. During launch operations toxic hazard corridors (THCs) may be produced for nominal and catastrophic abort launches, depending on the booster type. THCs show areas of predicted concentrations of either hydrogen chloride (HCL) gas and/or hypergolic propellant oxidizer and fuel vapors that exceed maximum allowable levels identified in a 3-tiered hazard assessment methodology. SE personnel will decide, based on pre-determined criteria, whether the population center should be evacuated or notified to take precautions and make appropriate recommendations to the 30 SW Commander.

GO/NO GO recommendations will be based on the point in the countdown, the population centers threatened, their locations, prior emergent response plans, etc. When Tier 3 THCs are predicted to extend off-base and over land, the analyst will notify the base command post (30 SW/CP), which will forward the information to the proper county agencies. There is a wide range of predicted weather parameters that determine where THCs will lay. /Detailed SE response criteria can be found in SE Operating Instruction 127-2, Heated Exhaust Toxic Contol Procedures.

2.4.2.6.4 Launch Area Toxic Risk Analysis (LATRA)

The Launch Area Toxic Risk Analysis (LATRA) is the model used for probabilistic risk assessment. It is operated on a second laptop PC in the MFCC. LATRA is the basis for GO/NO GO recommendations regarding potential or expected toxic exposures. It contains a modified version of REEDM which computes 200-1000 iterations via a Monte Carlo technique in which the meteorological forecast and time of failure are statistically varied. Input includes the internal REEDM predictions, vehicle failure rate, population centers on and off base, shelter types, health sensitivity categories, and exposure response function. Output includes casualty expectation as a function of sheltering/non-sheltering, mission essential/non-mission-essential personnel, minor/significant health effect, and individual/collective risk criteria. After liftoff, LATRA in no longer used, if a catastrophic abort occurs, only REEDM will be run.

2.4.2.6.5 Impact Limit Lines (ILL)

Impact Limit Lines (ILL) are established to define the launch and downrange areas to be protected. Significant debris pieces that could cause personal injury or property damage from a malfunctioning launch vehicle must be contained inside the ILLs. In the immediate launch area, the ILLs are drawn in order to provide protection for critical and/or expensive facilities, and public areas that could be exposed to risks associated with launch operations. The public is normally excluded from sites that are within the ILL and, hence, the public risks are negligible (see Figure 2-5).

2.4.2.6.6 Destruct Lines

Destruct lines are designed to protect areas behind ILLs from vehicle malfunctions that result in violation of a mission rule. The destruct lines are presented as solid lines on the Range Safety display IIP maps and are offset from the ILLs to account for launch vehicle debris dispersions that result

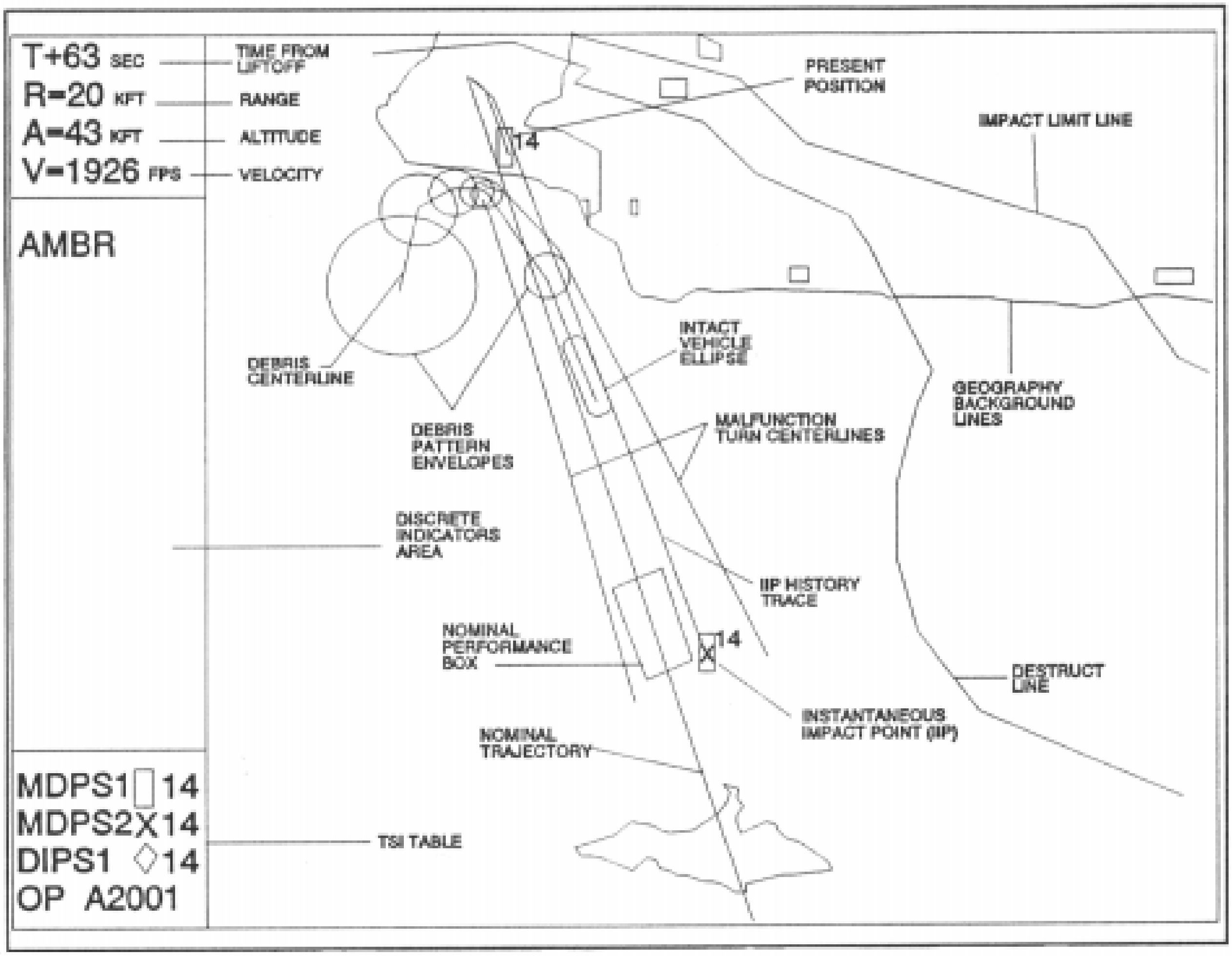


Figure 2 - 5: Real-Time Debris Footprint

from flight termination, auto-destruct, or self-destruct actions. It should be noted that the left destruct line follows the coast while the right side opens up for orbital vehicles. This is due to the fact that there are no land masses for a considerable distance on the right side of the trajectory. Activation of the flight termination system by the MFCO, upon violation of the destruct lines, significantly reduces the risk that debris will violate the ILL boundaries The separation distance between destruct lines and ILLs is a

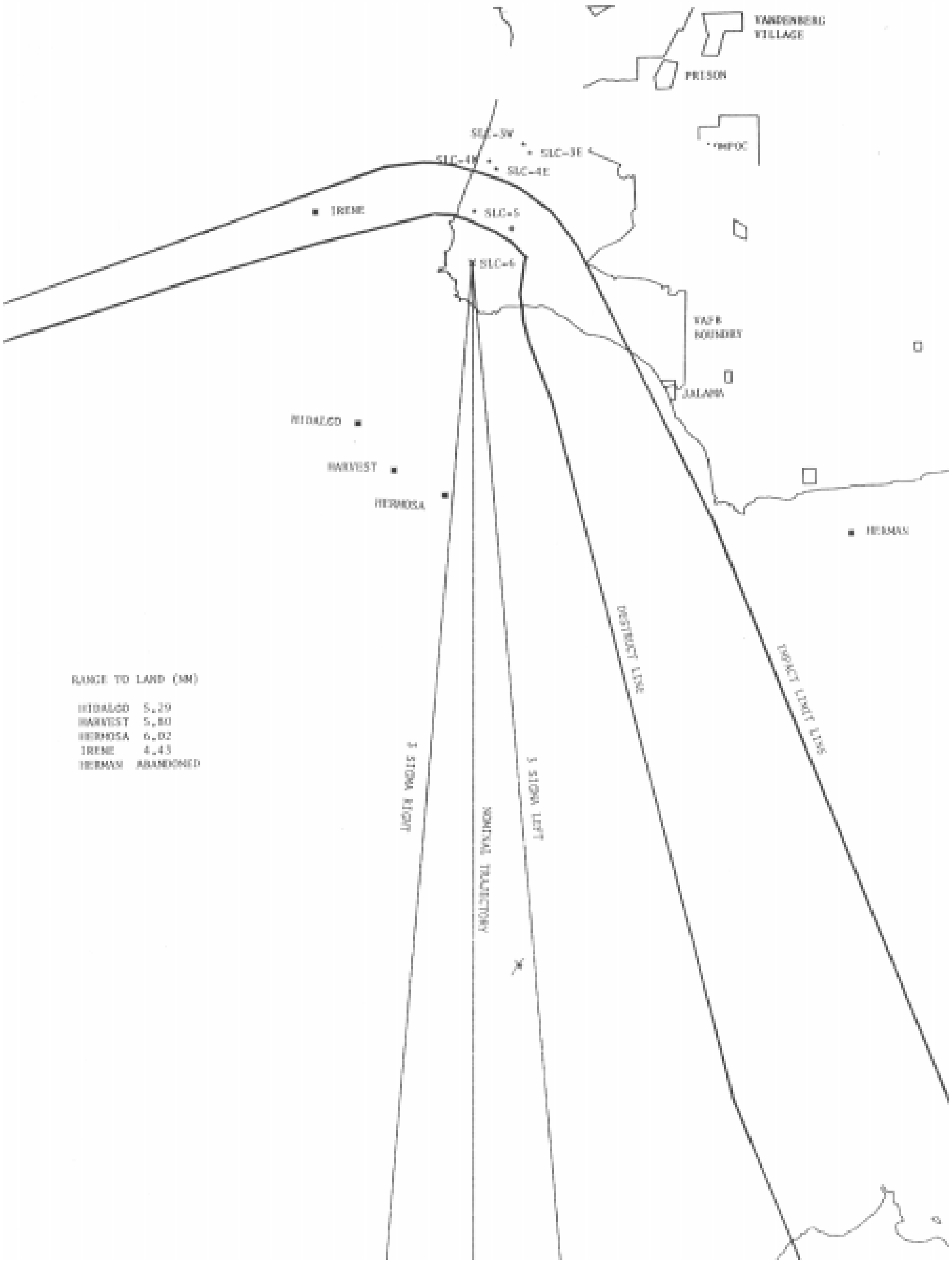


Figure 2 - 6: Typical Impact Limit Lines and Destruct Lines

function of system delays, MFCO reaction time, winds, explosion velocities, and performance characteristics of the vehicle (see Figure 2-6).

The real-time debris footprint is displayed on the RSDS and viewed by the MFCO during flight. The display is the end result of efforts to prepare a mission support database for an operation. Various types of information are available to the MFCO in order to make decisions regarding the public risk from a launch vehicle. Time from liftoff, vehicle range, acceleration, and velocity are displayed in the upper left of the screen. Mission discrete information, such as MTE and destruct, appear in the left center portion of the screen. Tracking information appears in the lower left portion of the screen as well as the sensor table (not shown) located at the bottom of the screen.

2.4.2.6.4 Instantaneous Impact Point

Real-time computer programs receive tracking system and telemetered vehicle data from the Western Range and other instrumentation systems. The real-time computer system computes the IIP of the vehicle and outputs the information to the Range Safety Display System. The reference nominal and three-sigma trajectories are displayed along with applicable destruct lines/criteria as background references. The MFCO monitors the real-time IIP throughout powered flight.

2.4.2.6.5 Downrange Safety Criteria

The downrange portion of the background display is prepared for the protection of downrange critical areas. These displays consist of flight termination criteria in the form of destruct lines, that protect downrange critical areas from the launch point to the end of powered flight or orbital injection, and informational plots of the nominal and three-sigma right and left vacuum impact point loci. The three-sigma impact point loci define the normal limits of lateral impact point dispersions, considering winds and performance variations. The real-time IIP is calculated at up to twenty points per second and sent to the Range Safety displays. Staging times and other critical in-flight events are also shown as background data for the MFCO (see Figures 2-5 and 2-6). For vehicles that overfly the tip of South America the left destruct line stops at the point where destruct action will no longer protect the land mass for a vehicle performing within 3 sigma of the nominal. Vehicles are typically about to go orbital at this point and dwell time over South America is typically 2-3 seconds. Events that would allow separated pieces to make land impact should not occur over South America or any other populated land mass over which overflight occurs.

2.4.2.7 Flight Safety Data

The range user must provide data to SEY that can be used to process a Flight Plan Approval request and prepare the safety criteria for the launch of a vehicle. The lead times (see Table 2-1) and procedures required for submitting data to SEY are included in EWR 127-1. Required data fall into three groups: trajectory data, vehicle turning rates, and vehicle breakup data. Additional information required includes propellant characteristics and other descriptions of the performance capability of the vehicle that does not lend itself to a digital format. Examples of such performance information could be typical vehicle failures, reliability of stages, and payload description.

- Trajectory Data. The purpose of the different trajectories (nominal, three-sigma right, three-sigma left, maximum,, minimum, etc.) that are provided to SEY is to identify an expected trajectory (referred to as nominal) and the spatial bounds of a vehicle performing within normal limits. Position data that are presented on launch-area, present-position displays define the region of user-described normal vehicle performance. Instantaneous Impact Points (IIP) may be used in addition to position data for some vehicles. Vehicles performing within normal limits in the downrange area are defined by the three-sigma lateral (right or left deviation) impact points. These data are presented on IIP displays for comparison to the actual track of the vehicle.

- Vehicle Turning Rates. If the MFCO is required to terminate the flight of the vehicle, there are system delays, such as time to transmit destruct signal and MFCO response delays, that must be considered to safely contain the vehicle debris. As a result, there is a time delay that may occur during flight in which the vehicle's impact point may deviate prior to destruct. System delays affect the displayed position as the MFCO monitors the downrange flight of a vehicle. The region of possible impacts can be defined if the maximum angle that the velocity vector can turn through at any time in flight is known. This established the requirement for vehicle maximum turn rates.

- Vehicle Breakup Data. The vehicle debris catalog is significant in the preparation of destruct criteria. The analyst must model the entire breakup configuration with a relatively small number of debris classes. Some pieces, such as bottles, motors, and propellant chunks can explode upon impact causing hazardous overpressures or secondary fragments that cover a large area. Inert pieces can have different velocities imparted to them by pressure release or explosion. A further problem, especially in the launch area, is establishing the limits of protection for lighter pieces that may drift considerably in the presence of winds. Depending on the pieces selected to represent the vehicle breakup, it may be necessary to set constraints on the wind velocity and direction at the time of launch.

2.4.2.8 Operational Hazard Areas

Land areas around the launch pad are endangered by vehicles that malfunction during the minus count and the early stages of flight. Broad ocean areas are similarly endangered by non-nominal vehicles and by the impact of spent stages and other hardware from nominal vehicles. SEY identifies the endangered areas, quantifies the associated risks, and implements procedures to limit access of people, ships, and aircraft. Notice to Airman and Mariners, defining the affected areas, are published in hazardous areas notices, and the function of the Aeronautical Control Officer (ACO) is directed toward reducing the risks to these areas.

2.4.2.8.1 Flight Hazard Area (FHA)

The FHA (Figure 2-7) is defined as that area where significant danger to personnel and equipment would exist in the event of a malfunction during the early phases of launch vehicle flight. It is the ground and air space extending to an unlimited altitude and including the entire area where the risk of serious injury, death, or substantial property damage is so severe that it necessitates exclusion of all personnel and equipment not needed to conduct the launch operation. Only Mission Essential Personnel are allowed to be in this area during a launch operation. Access through control points to the area is controlled by security forces with an approval list/letter. Those within the area must be located in blast-hardened and approved shelters.

The FHA for any vehicle must enclose a blast overpressure radius of 2.0psi and the
$1x10^{-5}$ casualty expectation area.

2.4.2.8.2 Flight Caution Area (FCA)

The FCA (Figure 2-7) is defined as the area located outside the Flight Hazard Area where injury or property damage could occur because of a vehicle flight failure. This area is restricted and only essential personnel are allowed to remain within the FCA during launch operations. The FCA contour, which is plotted for launch operations, is based upon a risk of 1×10^{-6} to a single individual standing unprotected on the corridor boundary. The FCA is restricted to only mission-essential personnel during launch operations.

The corresponding blast overpressure radius for the FCA is 0.5 psi (see Figure 2-7).

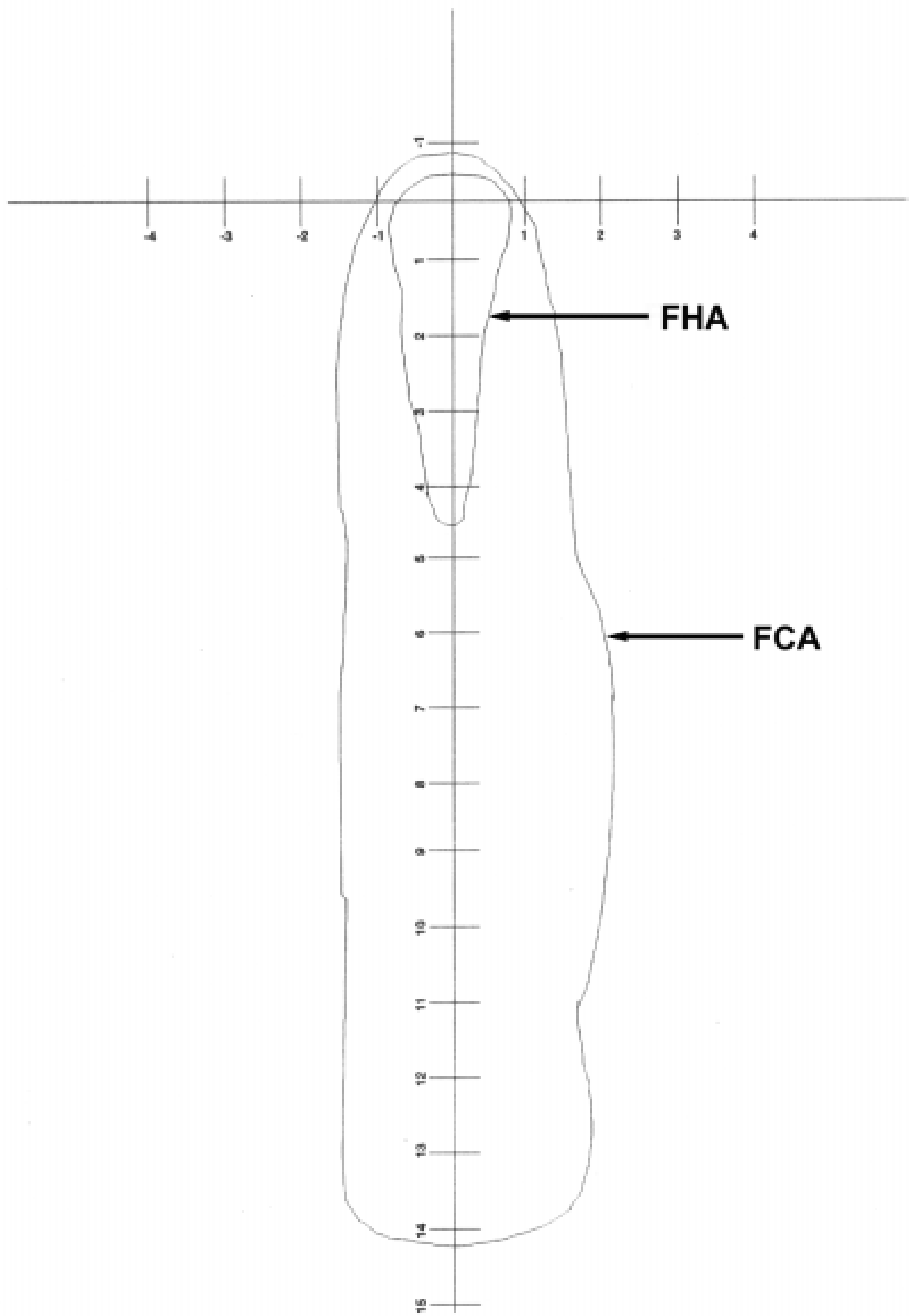


Figure 2 - 7: Typical Caution/Hazard Corridor

2.4.2.8.3 The FSA Ship Box

The Ship Box is a sea corridor extending from the launch point downrange, centered along the intended launch azimuth. The corridor is defined by creating a box around the 10^{-5} P_i contour. All danger zones (entire zones or portions thereof) lying within this corridor must be designated as closed (see Figure 2-8). SEY provides the charts to plot targets and probability contours to show the risks to boats and ships in and approaching the Ship Box (see Figure 2-8). Launch can be delayed if an individual probability of impact (P_i) to a ship is determined to be greater than 1 x 10^{-5} according to launch area boat and ship hit contours. Launch Area support aircraft are protected by using the 1 x 10^{-8} boat contour. For public aircraft, all airspace corridors the trajectory ground trace passes through (up to the point where the vehicle reaches 100,000 ft.) are closed. Notices to Airmen and Mariners are issued defining the areas and associated airspace for sea and air traffic.

2.4.2.8.4 Downrange Hazard/Caution Areas

In addition to the areas that are endangered by a malfunctioning vehicle, there are areas where spent stages and reentering bodies from normally-performing vehicles will impact. Two areas are constructed for each reentering object or group of objects reentering downrange.

- Hazard Area: These areas are constructed based upon the three-sigma debris dispersions of each reentering object. The hazard area encompasses the dispersion pattern determined by conducting a hazard analysis. All surface vessels and aircraft should remain clear of the hazard area during launch operations.

- Caution Area: These areas are buffer zones surrounding the Hazard Area described above. They are designed large enough to prohibit surface vessels that enter them at lift-off from navigating into the Hazard Area in the time it takes the reentering object or group of objects to impact. All non-mission-essential aircraft and surface vessels must remain clear of the Caution Area(s) during launch operations.

2.4.2.8.5 Hazardous Area Notices

Range Safety issues a hazardous area message for all launch operations describing the boundaries for hazardous areas in latitude and longitude coordinates. The message also indicates the time period after lift-off during which these areas must be avoided. In turn, Range Scheduling issues the following messages.

- Notice to Airman (NOTAM): This is a notification to civil and military aircraft, through the appropriate FAA facility, that defines possible hazards due to launch vehicle operations and the associated debris impact areas. Range Tasking sends the NOTAM to the FAA (FAA CARF, Washington DC) at

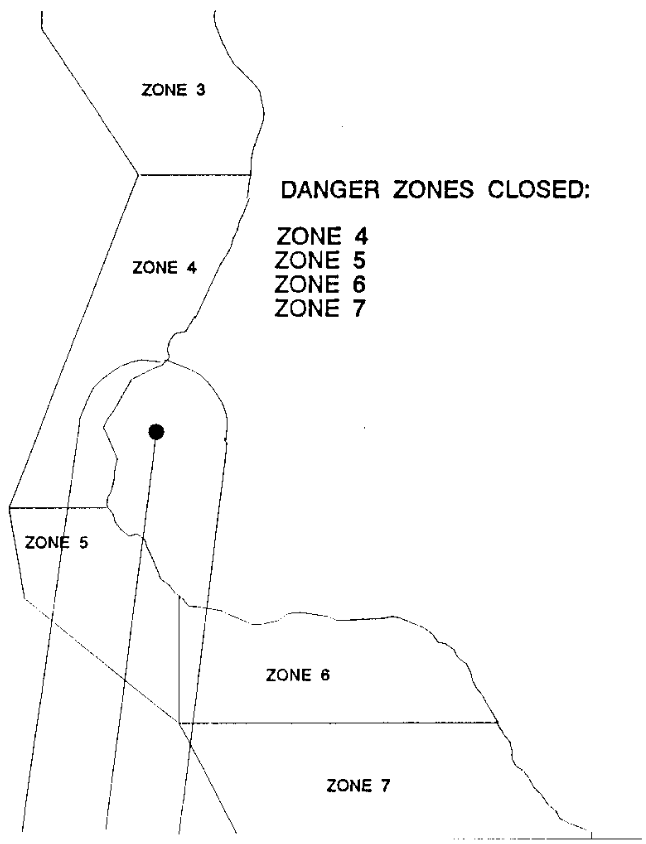


Figure 2 - 8: Danger Zones

L-7 working days. Updates are published daily. The NOTAM must be issued one week prior to the week of the affected date to assure publication.

- Local Notice to Mariners (LONOTE): This message provides hazard area notification to surface vessels in the near off-shore areas. It lists the danger zones and coordinates of the preliminary ship exclusion area and date of the operation. The LONOTE is submitted at L-7 working days as a Hazard Area Message to the Coast Guard. The notices are published in the weekly US Coast Guard Long Beach Local Notice to Mariners. The 30th SW also provides blind radio broadcast notification on selected frequencies, starting 24 hours before a scheduled operation, and notifies the Port Control Offices by telephone for posting by Harbormasters for fishermen and small craft operators.

- Local Airspace Closure: Restricted Area 2517 is always closed. Other airspace requirements are coordinated with FAA by the 30 RANS/DOUS Range Tasking Officer.

- Oil Rig Evacuation: Range Scheduling provides offshore oil platform evacuation information to Minerals Management Service (MMS) at L-20 days.

MMS then informs the oil companies at L-10 days per agreements. The information is confidentially supplied to the rig supervisor. The supervisor informs the crew at L-1 day. The platforms are clear by T-60 minutes. Although the MMS agreements are currently incorporated as part of the Commercial Lease stipulations these procedures are being renegotiated at Oil Company request for Commercial Launches.

Hydrographic Center, Pacific (HYDROPAC) NAVAREA 12: This is a special notice to mariners that defines the broad ocean hazard areas in the Pacific Ocean. The HYDROPAC is a notice for boats and ships. It is sent at L-7 working days to NIMA Navsafety, Bethesda, MD, and affected Government agencies around the World. Coast Guard units incorporate the information into their notices which are sent to customers in teletype form on a daily basis.

- FAA Notices:

  Central Altitude Reservation Function (CARF) - Altitude Reservations (ALTREV). The 30 RANS/DOUS Range Tasking Officer or his representative prepares an ALTREV request and sends it to the FAA. As the FAA requires five days notice before issuing the ALTREV the request them 5 days prior to L-5days. The notice is then issued by Oakland Center by L-3 to L-5 days.

- Coast Guard Notices:

  Notice to Mariners (NOTMAR): This is a weekly notice package issued by the Long Beach station that applies to danger zones only. The Coast Guard receives data on Thursday of the week prior to an operation. The NOTMAR is printed every Tuesday. Danger zone 4 is always restricted to transiting vessels only.

- Harbormaster Notices:

  Two weeks notice is required by the Harbormaster before notices are posted. Notices are published immediately and affect the area from Morro Bay to Pt. Hueneme. For information, there is a toll free number available to mariners three days prior to an operation. Warning radio broadcasts begin on L-1 day at 0900 and 1200. 30 RANS/DOUS issues a letter asking the Harbormaster to post a notice. The letter identifies the areas by latitude and longitude or Danger Zone number.

- Trainmaster Notices:

  The Union Pacific (UP) Railroad traverses Vandenberg AFB from a point north near Casmalia to the south at Sudden Ranch. The right-of-way on VAFB is the property of the railroad and not the Government; however, the SP will slow, speed, or stop freight trains to avoid hazardous conditions associated with vehicle launches. The trainmaster is a SP employee and serves as a liaison between the railroad and the Government during launch operations. The trainmaster must be notified no later than five duty days prior to the launch for support. Notification is in the form of a letter from 30 RANS/DOUS stating the times of concern and identifying the hazard area by railway mile-markers bounding the area of concern. The Trainmaster issues no notices but coordinates with other stations up and down the line and with train engineers as required. The Aeronautical Control Officer (ACO) has a direct line to the Trainmaster at the Surf Train Station for realtime coordination.

- County Sheriff Notice:

  The Santa Barbara County Sheriff is occasionally notified to close highway 246 at the South VAFB gate location, thereby closing access to Ocean Beach Park. This prevents the local public from traversing through the impact limit line or caution/hazard corridors during launch operations. The Sheriff may also be called to stand by to evacuate residents in the Miguelito Canyon area. The Sheriff is notified by the 30th Security Forces Squadron (SFS) by L-10 days. Residents are notified of the hazard and the requirement to evacuate. The Sheriff will assign deputies to monitor the area while the evacuation is in effect to prevent loitering, and protect the property of those who chose to evacuate. Communications between the Range and the Deputies is accomplished through a Sheriff's representative in the Command Post and a 30 SFS member with each deputy.

- Ranger Notices:

  Some launch activities may require the closing of Jalama Beach. When Jalama is closed, signs are posted for the public by L-3 days. The decision to close Jalama Beach is made by the 30 SW commander based on 30 SW/SE requirements and recommendations. 30 RANS/DOUN notifies the Security Forces who in turn notify the Rangers at L-10 days. When Jalama is closed, the Sheriff has contact with the Range through his/her chain of command and the Park Ranger have the 30 RANS/DOUS phone number for coordination.

2.4.2.8.6 Collision Avoidance (COLA)

It is the responsibility of SEY to predict the miss distance between the launch vehicle and space vehicle that are manned or capable of being manned. This responsibility extends to all jettisoned debris such as stages, shrouds, interstage panels, and Re-entry Vehicles.

The prediction is determined via a computer program that calculates when the launch should not occur due to possible intercept conflicts. The data required for the program is obtained from the commercial launch operator for the launch vehicle and from NORAD for the orbiting satellite. There is a safety buffer (approximately five minutes) added to the beginning and end of the intercept time period. The actual intercept periods are usually only one or two minutes in length. Protection criteria consists of the following:

- A 200 km (108 nm) separation between launched vehicles and satellites that are manned or capable of being manned;

- A five minute protection time between launched vehicles and satellite orbit intersections. This buffer time may be shortened by two to three minutes when necessary. The buffer is applied before and after the intercept time with the 200 km buffer-sphere.

2.4.3 Noncompliance With the Requirements of EWR 127-1

Range users are responsible for identifying all noncompliance's with EWR 127-1 to Range Safety for resolution. The three types of noncompliance's are: meets intent certifications (MICs), deviations, and waivers.

MICs are used when range users do not meet exact requirements, but do meet the intent of the requirements. Rationale for equivalent safety must be provided. NOTE: MICs are normally incorporated during the tailoring process (see par. 2.4.4.2 for tailoring process).

Deviations and waivers to the requirements of EWR 127-1 are used when the mission objectives of the range user cannot otherwise be achieved. Deviations are used when a design noncompliance is known to exist prior to hardware production, or an operational noncompliance is known to exist prior to beginning operations at the range.

Waivers are used when, through an error in the manufacturing process, or for other reasons, e.g. a hardware or software noncompliance is discovered after production, or an operational noncompliance is discovered after operations have begun at the range. Waivers are normally given for one flight and must be resolved prior to the next scheduled flight, if applicable.

2.4.3.1 Noncompliance Categories

MICs, waivers, and deviations issued by Range Safety at the Western Range are categorized as follows.

- Public Safety Waivers. These waivers involve risk to the general public or foreign countries and require approval by the Wing Commander. In some situations, the Secretary of Defense or the State Department must also concur. It should be noted that flight plan approvals (FPA), deviations, and/or waivers normally require extensive risk analyses that can take one to two years to perform, coordinate, and approve Therefore, users contemplating these requests should contact Range Safety far in advance of planned launch dates.

- Launch Site Safety Waivers. These waivers typically involve flight hardware, ground support equipment, or hazardous support systems. To obtain a waiver of this type requires positive and continuing mitigation controls that will ensure the risks to personnel and resources can be kept to acceptable limits in accordance with policies and criteria established by the 30th SW Commander. Strong justification and supporting technical data must be provided. These requests normally take one to two months to process; therefore, users contemplating requesting such waivers must inform Range Safety with sufficient lead time for proper consideration and response. Life-of-the-program waivers are granted only under extreme circumstances. The Chief of Safety approves these requests.

- Time Limit Deviations and Waivers. These differ from life-of-the-program waivers in that they are for a specified period of time. A time constraint is normally determined as a function of the time required to modify system design, obtain new hardware, change or modify procedures/operations, or obtain different equipment that meets the requirements being waived. Technical data and justification must be provided with supporting risk analyses. These waivers vary in time to process from two weeks to two months and users should anticipate appropriate lead times for proper processing. The Chief of Safety approves these requests.

2.4.3.2 Deviation and Waiver Policy

Deviations and waivers are controlled through the following.

- It is the policy of the range to avoid the use of deviations and waivers except in extremely rare situations, and they are granted only under unique and compelling circumstances. Range Safety and the range user jointly endeavor to ensure that all requirements of EWR 127-1 are met as early in the design process as possible to limit the number of required deviations and waivers to an absolute minimum.

- The Wing Commander has the authority to change, deviate from, or waive any requirement in the safety document for a specific program or mission operating at the range. Based on national or mission need, the Commander has the authority to accept risks for a specific mission that exceed those defined in the document.
  - Rationale for national need or mission requirements must be explained.
  - Acceptable risk mitigation and “get well” plans must be provided since they are an integral part of the basis for approval.

- When granted, deviations and waivers are normally given for a defined period of time or a given number of missions until a design or operational change can be implemented.

2.4.3.3 Deviation and Waiver Request Submittal

All deviation and waiver requests must be submitted formally, in writing, by the commercial launch operator to the Chief of Safety. Deviations should be addressed during preliminary and critical design reviews or safety reviews. Range Safety and the range user jointly agree, during the planning phase of the program, to acceptable time lines and closure dates for all major hazardous system design efforts. This will help to identify any schedule impact allowing for Range Safety review and response to the commercial launch operator before the hardware manufacturing starts, or is adversely affected. Deviation and waiver requests include the reason for the request, full justification, analysis of additional risks (if waiver is approved), proposed methods for mitigating the risks, and supporting technical studies. Cost and schedule impacts, by themselves, are not sufficient justification for approval, but may be provided as additional factors for consideration.

2.4.3.4 Meets Intent Certification

Meets Intent Certifications (MIC) are used when the commercial launch operator does not meet the requirements of EWR 127-1 as specifically stated, but the intent or spirit of the requirement is satisfied. A statement of justification is required for each MIC submission. MICs are normally reviewed and incorporated during the tailoring process.

2.4.4 Range Safety and Range User Interface Process

The cost of changes in hardware, as well as the impact on time schedules, can be reduced by joint planning between Range Safety and the commercial launch operator. The goal of the interface process is to provide final Range Safety approvals for launch as early as possible.

2.4.4.1 Initial Range Safety and Commercial Launch Operator Technical Interchange Meeting

Commercial launch operators should contact Range Safety to arrange an initial Technical Interchange Meeting (TIM) during the concept phase of a program. The purpose of this meeting is to present program concepts regarding flight plans; launch complex selection; launch vehicle, payload, and ground support equipment; range safety system; facility design; operations; and launch complex safety responsibility, to determine if there are any major safety concerns that could impact the program. This TIM may occur at any time but should be no later than the formal Program Introduction in accordance with the Universal Documentation System.

2.4.4.2 Tailoring Process

Once a Program Introduction has been accepted by the WR, Range Safety initiates a meeting with the prospective commercial launch operator to establish a High Performance Work Team. When the commercial launch operator decides and officially notifies the range that they will use the WR, the work team is activated. The goal of the High Performance Team is mutually-acceptable, tailored requirements. In those situations where mutual agreement is not achieved, an appeal to the next level of WR organizational responsibility is heard. The appeal channels follow the management and functional organizational arrangement. The team's task includes the following:

- Definition and identification of all hazardous systems associated with launch vehicle and/or payload;

- Description of vehicle flight path in terms of azimuth and trajectory;

- Definition of launch vehicle configuration, performance characteristics, and program mission requirements;

- Failure modes and failure probabilities of the launch vehicle and/or payloads;

- Definition and description of facilities required, including launch complex, hazardous assembly and checkout areas, and ordnance and propellant storage requirements;

- Based on the results of the initial High Performance Work Team (HPWT) evaluation, each chapter of EWR 127-1 is tailored to specific requirements for the mission. The tailoring effort progresses and becomes more detailed as the program definition phase moves from concept through preliminary and critical design reviews. The HPWT establishes a documented 127-1 tailored baseline, which is used throughout the life of the program and is modified as new data is available and modifications are made. The baseline documents each EWR 127-1 requirement;

- Documentation is maintained by the team regarding agreements, problem issue closeouts, waivers, deviations, and meets intent certifications.

Membership on the HPWT includes Range Safety representatives responsible for flight termination system design, flight plan approval, destruct criteria development, system safety, and facilities design. Depending on size and scope of the mission and/or the program, Range Safety membership can range from one to four individuals. The commercial launch operator is requested to provide participants who are familiar with, and responsible for, development of the FTS, launch vehicle and payload configuration, vehicle performance characteristics, failure modes, breakup parameters, operational flow process, facility requirements, and launch vehicle hazardous systems. This could require participation from three to ten individuals from the commercial launch operator's organization. Each new program is defined from the concept phase through the critical design review, and includes the following:

- Complete vehicle description, including number of stages, types of propellant, payload description, type of guidance system;

- Vehicle performance and mission characteristics and planned number of launches;

- Planned launch azimuth and trajectories, acceleration and velocity, and identification of landmass overflight are provided in a preliminary form as soon as possible and modified as more detail is available. Vehicle thrust and weight ratios, and acceleration parameters are defined;

- Turn rates, Max-Q and time of Max-Q, malfunction time, and breakup characteristics are developed and defined. Breakup characteristics based on failure modes and failure probabilities are developed;

- Requirement for risk assessment is defined, and schedules are developed to determine need dates;

- Preliminary destruct criteria and mission rules are defined, and FTS requirements are defined/tailored to meet specific programs;

- The tailored version of EWR 127-1 will be used in the design, qualification and acceptance tests, data submittals, and Range Safety review and approval.

2.4.4.3 Other Range Safety and Commercial Launch Operator TIMs and Reviews

Commercial launch operators and Range Safety jointly agree to arrange the following TIMs and reviews as necessary:

- Flight Safety TIMs;

- As required, combined or independent safety reviews in association with the Concept Design Review (CDR), Preliminary Design Review (PDR), and Critical Design Review (CDR) for launch vehicle, payload, and associated ground support equipment design, airborne Range Safety System and associated ground support equipment design, critical facility design, and ground operations plans;
    - CDRs provide design and operations detail to at least the system level;
    - PDRs provide design and operations detail to at least the subsystem and box level;
    - CDRs provide design and operating detail to the component and piece part level;

- Hazardous and Safety Critical Procedures TIMs;

- Other TIMs, reviews, and meetings as necessary.

2.4.4.4 Safety Documentation Requirements

Chapters 1 through 7 of EWR 127-1 have Documentation Requirements sections. These sections describe the information that must be submitted and the processes to obtain the necessary approvals to launch from the WR.

- Tailored EWR 127-1, System Safety Program Plan, Noncompliance Requests, and Safety Training and Certification Plan;
  - If desired, a range user and Range Safety jointly tailored EWR 127-1 may be developed (See EWR 127-1, Chapter 1, Appendix 1A);
  - A Systems Safety Program Plan (SSPP) must be approved at least 45 days prior to any program CDR (See EWR 127-1, Chapter 1, Appendix 1B);
  - Noncompliance requests must be submitted for all identified noncompliance's to the document (See EWR 127-1, Chapter 1, Appendix 1C);
  - If a control authority desires to assume launch complex safety responsibility, a Safety Training and Certification Plan must be approved by Range Safety prior to assumption of this responsibility.
- Flight Data Packages (FDP), Intended Support Plans (ISP), and Directed Energy Plans (DEP);
  - The Preliminary FDP and Final FDP must be approved prior to the final Launch Readiness Reviews (LRRs);
  - ISPs must be approved prior to the LRR;
  - DEPs must be approved prior to the LRR;
  - Content requirements may be found in EWR 127-1, Chapter 2.
- Missile System Prelaunch Safety Package. The MSPSP, including design documentation, initial test plans and test reports, and recertification requirements for all hazardous and safety critical launch vehicle and payload systems, ground support equipment, facilities, their interfaces and operations, shall be approved prior to hardware arrival and/or use at the range (See EWR 127-1, Chapter 3 and Appendix 3A);

- Airborne Range Safety System Report. The airborne RSSR, including all design documentation, test plans, and test reports for the Flight Termination System, Range Tracking System, and Telemetry Data Tracking System must be approved prior to launch (See EWR 127-1, Chapter 4 and Appendix 4A);

- Ground Operations Plan and Hazardous and Safety Critical Procedures (See EWR 127-1, Chapter 6 and Appendixes 6A and 6B);
  - The GOP must be approved prior to the start of operations at the range;
  - Hazardous and safety critical procedures must be approved by Range Safety prior to their use at the range.
- Facilities Safety Data Package. The FSDP must be approved prior to facility use (See EWR 127-1, Chapter 5 and Appendix 5A);

- Range Safety Operations Requirement (RSOR). Range Safety develops and publishes a Range Safety Operations Requirement (RSOR) document for each applicable launch vehicle. The RSOR is approved by the Chief of Safety or his designated representative and distributed no later than L-60 days. It documents exceptions to the standard provisions of EWR 127-1 and may also levy additional safety requirements peculiar to a launch vehicle series. Range Safety instrumentation, tracking data and display requirements are referenced in this document;

- Operations Supplement (OpsSup). Range Safety also develops and publishes an OpsSup containing additional information or requirements particular to a given launch and which are not contained in the RSOR or EWR 127-1. The OpsSup is approved by the Chief of Safety or his designated representative and distributed no later than F-5 working days for each launch operation. Range Safety instrumentation, tracking data and display requirements are also referenced in this document;

- Launch Operations Approval Letter. 30th SW/SE Launch Operations Approval to launch from or onto the range must be obtained by the commercial launch operator not later than the scheduled LRR. Issuance of this letter depends on the range user having obtained the previously required approvals described in EWR 127-1, Chapter 1;

- Final Range Safety Approval to Launch.
  - Holdfire checks, Range Safety System checks, and other safety critical checks must be performed satisfactorily; environmental conditions must be met; and all Range Safety launch commit criteria must be “green” prior to final approval to launch;
  - Given that holdfire checks, Range Safety System checks, other safety critical checks, and environmental conditions are satisfactory, and all Range Safety launch commit criteria are “green”, Range Safety will provide a final approval to launch as follows: The MFCO issues a “GREEN to go” electronically through the hold-fire indicator system and a verbal call ”Safety is sending a green.”

2.4.5 Range Safety “Concept to Launch” Process

The overall Range Safety process from “concept to launch” for new launch vehicles is shown in Figure 2-8. This process may be tailored to apply to payloads, ground support equipment, critical facilities, and/or hazardous and safety critical operations. The top row of boxes represents the subprocesses for establishing the program concept and applicable Range Safety requirements. The second row of boxes represents the subprocesses for analysis, design, and test for the program. The third row of boxes represents the subprocesses for operations and launch at the range. Details of the steps of this process can be found in the applicable Chapters of EWR 127-1. In addition, the Range User Handbook describes this process in greater detail. NOTE: Appendix 1F of EWR 127-1 contains a detailed, tailored version of this process specifically developed for generic payloads and payload buses.

Range Safety milestones are those events that must occur for Range Safety to approve a program during the “concept to launch” cycle. Time frames and event schedules vary depending upon the complexity of the program. The time frames in Figure 2-9 provide a general schedule of events as guidance for new, major launch vehicle programs. For smaller vehicles and payloads, these time frames can be compressed to a year or less. Time frame requirements for Range Safety and the range users throughout EWR 127-1 are baselines for all programs; however, they may be altered during the tailoring process.

2.4.6 Range Safety Launch Operations

This section contains policies, identifies requirements, and describes procedures used by Mission Flight Control Officers (MFCOs), acting for the Wing Range Commander, to maintain positive control of ballistic missiles and space vehicles launched from the Western Range.

2.4.6.1 Range Safety Operations Responsibilities

The MFCO is responsible for in-flight safety that includes taking all necessary precautions to minimize the risks to life and property, while not unduly restricting a non-nominal vehicle that has not violated flight termination criteria. Air Force officers and DOD civilians serve as MFCOs. In addition to the two MFCOs manning the two safety consoles in the Test Operations Control Center (TOCC), there are supporting MFCOs at the telemetry console and at the Forward Observer positions.

- The capability to ensure that launched vehicles do not violate approved flight rules is imperative for the public safety; therefore, the primary responsibility of the MFCO is to monitor the progress of a launched missile or space vehicle

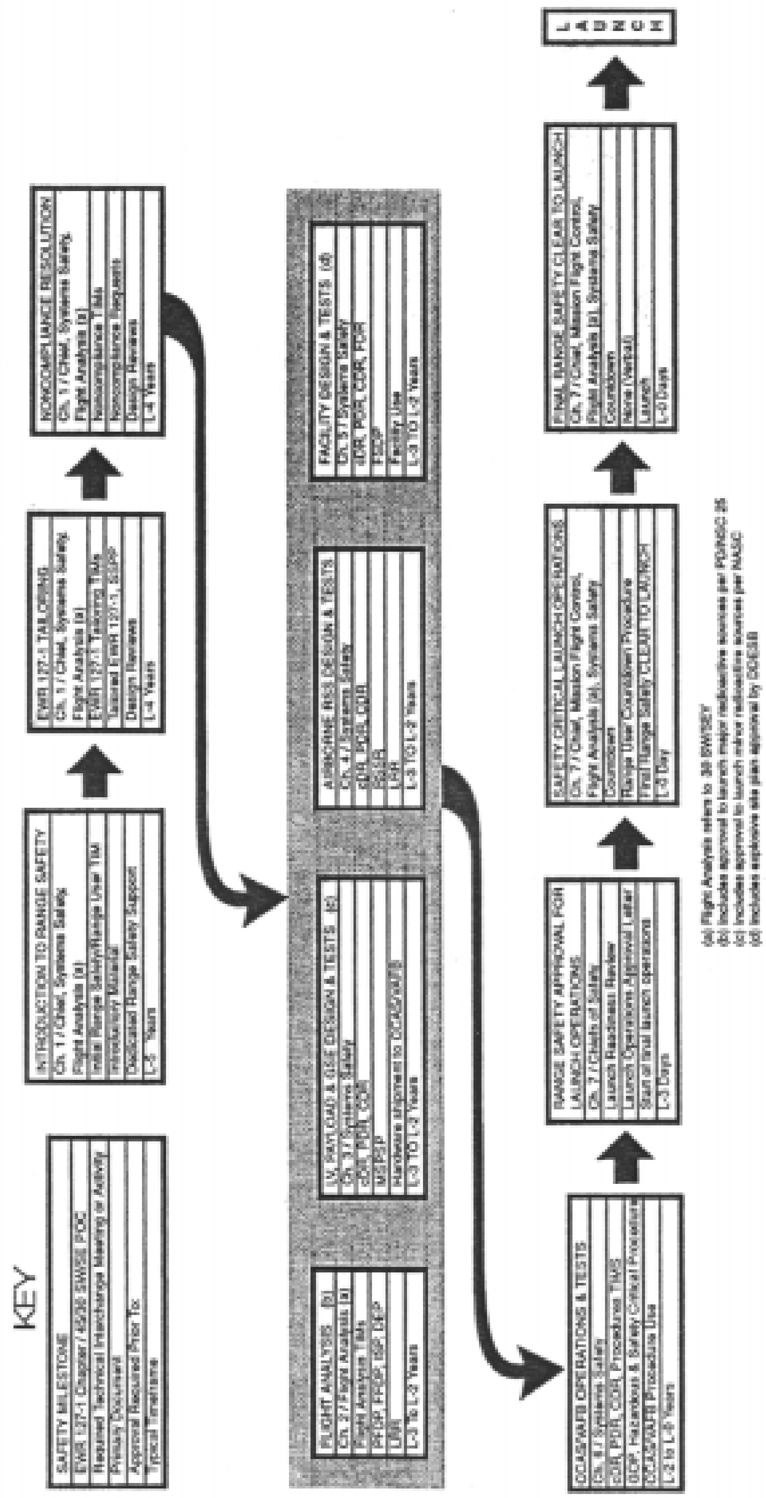


Figure 2 - 9: Range Safety "Concept to Launch" Process

and determine if its flight should continue or be terminated. The MFCO will normally take flight termination action under the following conditions.

- Obviously Erratic Flight - Vehicle performance is such that the potential exists for loss of flight termination control as the result of a gross flight deviation or obviously erratic flight, and further flight is likely to increase public risk. This action may be taken even though the launch vehicle has not violated flight safety criteria;

- Flight Safety Criteria Violation - Valid data shows that the launch vehicle has violated established flight safety criteria;

- Performance Unknown - Launch vehicle performance is unknown and the capability exists to violate flight safety criteria. NOTE: If the launch vehicle has been nominal for an extended period of flight before the status becomes unknown, the MFCO may allow the flight to continue;

- At the written request of the range user, the MFCO may implement special command requirements such as FUEL CUTOFF or SAFE (RF DISABLE).

Flight termination for liquid-fuel boosters consists of fuel cutoff (arm command) followed by destruct (destruct command). In some cases, destruct action may not be required after engine shutdown (thrust termination) has been confirmed. For solid-propellant boosters, there is no means to terminate thrust except to send the destruct command.

2.4.6.2 Surveillance/Clearance

Surveillance and clearance of land, sea, and air areas in the vicinity of the WR is necessary to ensure that launch vehicle operations take place in a safe environment.

2.4.6.2.1 Air Control operations

The Aeronautical Control Officer (ACO) controls those geographic areas specifically assigned to the range during launch operations, exercises control of all traffic, surveillance, and display equipment to assure that airspace, water, and land areas specified by SEY are clear of unauthorized ships, aircraft, vehicles, trains, and personnel during launch. The ACO is either a Range Technical Services Contractor individual or a member of the 30 RANS (Range Squadron) who informs the MFCO of the current status and changes in status of the hazard and impact areas.

An Air Controller is responsible for the control of assigned launch support helicopters and for the reporting and display of contacts visually sighted and reported by helicopter personnel. The controller keeps the ACO informed of the location of personnel and vehicles in danger, hazard, or caution areas during launch operations.

2.4.6.2.2 Surface Surveillance

The Air Controller provides command and control of the surveillance aircraft assigned to clearance of over-water areas adjacent to the WR. The primary mission of the surveillance aircraft is to locate and identify vessels present in off-shore areas and to pass requests and instructions initiated by the ACO to such vessels. The surveillance aircraft is only used on selected operations.

The Surface Search Radar Operator assures that all surface contacts in the shipping hazard area are monitored by search radar. All contacts detected by the search radar are reported to the Precision Surface Plotter. The Precision Plot Board operator receives range and bearings to all surface contacts within, or expected to enter, the designated hazard areas. Contacts are plotted on appropriate charts and computations of course and speed are provided that predict the time targets will penetrate and clear hazard areas. The targets will also be predicted ahead to window opening plotted on a table mounted chart and made available to the MFCO via a video link.

Advance notices to local Harbormasters advise marine vessels and the US Coast Guard of Danger Zone closures. The US Coast Guard, in turn, broadcasts the information on the standard marine frequencies for all mariners. Ships at sea are advised of the hazard area by merchant ship broadcasts (MERCAST) and Hydrographic Notices to Mariners in the Pacific (HYDROPACS). Aircraft pilots on overseas and domestic routes are advised of hazard areas by a Notice to Airmen (NOTAM) (see paragraph 2.4.2.8.5).

As part of this surveillance effort, a service contract with the Union Pacific (UP) provides for reporting of train traffic through VAFB during missile countdowns and launches. The UP provides a trainmaster stationed at Guadalupe train station for 30 SW missile operations who is in communication with the ACO via direct telephone line. The ACO provides appropriate telephone notices and radio broadcasts on T-1 day. On all launches that require protection of UP railroad track, the ACO ensures that an operator is provided for the Automated Train Surveillance System (ATSS).

2.4.6.2.3 Automated Train Surveillance System

The ATSS consists of sensors located along the railroad tracks at various points from Guadalupe (north of VAFB) to Gaviota (southeast of VAFB). A central processor and displays are located in the Missile Flight Control Center (MFCC) and the Area Control Center (ACC). Passing trains activate the sensors and the processor displays their signals in the MFCC and the ACC and may necessitate a launch hold. The ATSS provides the MFCO and the ACO with real-time information on train movement so that they can predict times into, and out of, protected areas. The ATSS processor will also pass mile-marker locations of trains to the RSDS for real time display.

2.4.6.3 Weather Systems

Weather support is provided by personnel of the 30th Weather Squadron, 30th Operations Group, who operate the VAFB weather support facility. In addition to weather forecaster, equipment maintenance, and surface, upper-atmospheric, and ionospheric observer personnel, a team of meteorologists is assigned to provide the experience and expertise necessary to support the 30 SW mission. The team provides mission-tailored support for specific missions and consultation services to staff agencies and range users during all phases of program evolution. Supporting agencies may include the other National Ranges, the 41st Rescue and Weather Reconnaissance Wing, the Air Force Global Weather Central, the USAF Environmental Technical Applications Center, or the Air Force Geophysics Laboratory.

The MDPS performs wind-effects calculations for Range Safety on the morning of L-1 day and again at approximately L-5 h on launch day for all major launches. The following procedures are established:

- By F-45 days, Flight Analysis forwards a Range Order to the ROMSSC defining station constants, ballistic coefficients, and trajectory data to be used in developing debris risk assessments and RSDS background displays;

- On F-1 day and at the time specified in the RSOR for each vehicle, Range Weather Operations provides forecasts of T-0 files. The wind files are used for all prelaunch safety risk assessments;

- The Range Safety wind check program is run by L-4.5 h to provide an indication of how the actual winds compare to the Inter-range Instrumentation Group (IRIG) statistical winds. The results are made available to Flight Analysis;

- If a HOLD invalidates the predicted wind data, or if a later wind prediction is made, it may be necessary to repeat the above calculations as late as T-1 h.

2.4.6.4 Range Safety System

Personnel of the ROMSSC provide the Mission Flight Control Officer with real-time vehicle flight performance data, with the means to terminate the flight of vehicles that violate safety constraints, and with the communications necessary to ensure safety criteria are met. The Missile Flight Control Center (MFCC), located within the Launch Operations Control Center (LOCC), Bldg. 7000, serves as the control area from which flight termination commands can be initiated in cases of errant or malfunctioning launch vehicles. The MFCC is comprised of several consoles and operating positions that help to insure that the MFCO has the real-time display of launch vehicle position to assist in the mission abort decision if flight criteria are violated. The MFCC is the central control point for all 30 SW vehicle flight control-related activities. Different consoles are available to control and monitor the range. Each console controller performs specific tests and simulations with his assigned systems to ensure they are ready for real-time launch support. The following is a functional description of the consoles and activities that support the MFCO.

2.4.6.4.1 Real-Time Data Controller (RTDC)

The RTDC is responsible for controlling and validating the range tracking sensors providing data, and the vehicle flight control computers that process the data for display in the MFCC. Various tests, including simulations and playbacks of previously-recorded vehicle launches, are used to insure that data to be displayed in the MFCC accurately and precisely present vehicle position and performance. The RTDC console is capable of both automatic and manual selection of tracking sources. Two CRT displays provide visual vehicle position data and status information on all tracking systems. The RTDC will deselect invalid tracking systems from being used in calculating acquisition outputs.

2.4.6.4.2 Acquisition Data Systems Controller (ADSC)

The ADSC is responsible for providing “best source” acquisition data to the various tracking sensors. The ADSC performs tests and validations with the primary Acquisition Display System (ADS) and the secondary Digital Information Processing Systems (DIPS). Both of these computers provide unclassified acquisition data. The ADSC console is capable of both manual and automatic selection of acquisition data. Two CRT displays provide information on the quality of each radar track.

2.4.6.4.3 Mission Flight Control Officer Console

The MFCO is responsible for missile flight control. From his console, the MFCO is able to monitor launch vehicle performance data acquired by radar, telemetry, and optical tracking systems. The MFCO console contains the control switches required to initiate the flight termination sequence. The Senior MFCO (SMFCO) is collocated with the MFCO on an identical console and assists with problems during the prelaunch countdown and, when time permits, provides information and concurrence with the decision to terminate vehicle flight. The SMFCO monitors displays and communicates with range safety support personnel and other agencies.

2.4.6.4.4 Telemetry Display System Console

The Telemetry Display System Console provides the MFCO with 16 bar charts, three analog display channels, and telemetry data, plus various status messages. Specific telemetry display requirements for a particular mission are listed in the Range Safety Operations Requirements document (i.e., vehicle chamber pressure, roll, pitch, and yaw, FTS status). Database parameters can be selected for each channel to illustrate out-of-tolerance conditions by a change of color or flashing conditions. This console is manned by personnel from the Missile Flight Control Section (SEO) and, on occasion, personnel from the SEY Section.

2.4.6.4.5 Command Transmitter Console (CTC) Controller

The Command Transmitter Console operator controls the configuration of the remote command transmitters. It is a CTC operator's responsibility to provide the MFCO with a command transmitter site in proper configuration at all times. The CTC is equipped with controls and feedbacks for all functions required to control the command transmitter sites. The CTC has displays to monitor the initiation of flight termination and control functions from the MFCO console, or functions from the auto abort logic of the flight control computer. The CTC is controlled by four microprocessors and their support logic. Each of these processors performs specific functions to insure no invalid commands are transmitted. Inputs to the CTC include auto abort functions generated by the metric data processing flight control computer (MDPS) and site status information. Outputs from the CTC include command messages to remote sites and status inputs to the MFCO and RTDC consoles (also see Section 1, par.. 1.2.2.6.4).

2.4.6.4.6 Computer/Display System

The flight control functions of the MFCC are supported by two computer systems. The dual Metric Data Processing Systems (MDPS) and the dual Range Safety Display Systems (RSDS) provide the MFCC with two complete independent range safety systems. The Acquisition Data System (ADS) provides acquisition data to all range control tracking systems. The MDPS receives several different types of radar and telemetry data. From this data, MDPS generates a multi-station and several single station solutions of present position and instantaneous impact predictions. The multi-station solutions provide the capability to identify and correct invalid inertial guidance data and provide a higher quality of data on which to make flight termination decisions. The multi-station capability provides auxiliary benefits of helping identify invalid sensor data. The RSDS provides the means by which real-time graphic and alphanumeric displays of vehicle performance metric data are presented to flight control personnel. These displays present not only the real-time vehicle information but background data including geography, nominal profiles, and debris contours. The various displays of vehicle performance are provided by RSDS and are selectable from the MFCO/RTDC/ADSC operating positions.

2.4.6.4.7 Skyscreen

The Skyscreen system is made up of three elements: the forward observers, the skyscreen TV, and the associated instrumentation and communications needed to input the Skyscreen information to the MFCC. Two Skyscreen systems support each launch and are designated Back Azimuth and Program. The Back Az position is located uprange from the launch point along the flight azimuth and the Program position is located cross-range from the launch point. The forward observer and TV may or may not be collocated. Skyscreen operators provided by ROMSSC set up and check out the Skyscreen systems prior to T-60 minutes, and operate the Skyscreen TV and communication systems.

Forward observers are individuals who have been certified by 30 SW/SEO to perform this duty. They are personnel from the SEO Section or occasionally, personnel from the SEY Section. Both Back Azimuth and Program observers report visual indications on the early phases of missile flight directly to the MFCO. Also, the Back Az observer uses two vertical, parallel wires aligned in a plane parallel to the flight trajectory plane. This Vertical Wire Skyscreen (VWSS) assists the Back Az observer in determining launch vehicle deviations from the normal flight azimuth. The VWSS is set up and aligned to within two degrees of the launch azimuth by the skyscreen operator.

The Skyscreen TV consists of a portable TV camera system, support van, and microwave equipment, and provides real-time television coverage of vehicle performance to the MFCO. The Program TV camera is aligned with the cursor slightly on the downrange side of the launch vehicle and the Back Az TV is aligned with the cursor slightly offset from the launch vehicle so that it does not obstruct the view of the launch vehicle. After liftoff, the camera operator centers the launch vehicle in the frame after it approaches the upper boundary of the screen and maintains track until visual contact is lost.

2.4.6.5 Command and Control System (CCS)

The CCS provides the MFCO with the capability to terminate launch vehicle flight if flight termination criteria are violated or mission rules call for MFCO action. CCS requirements are as follows:

- Ultra high frequency (UHF) transmission capability for flight termination commands is required throughout powered flight or until orbital insertion as dictated by the mission flown;

- Flight control command functions, including the capability to override, takes precedence over other commands that may be transmitted to or by command transmitter system sites;

- The command control transmitter field intensity along the nominal trajectory must show a 12 dB margin when subjected to a RF link analysis;

- Each command control transmitter supporting a launch must have a backup transmitter capable of maintaining the proper signal strength;
    - The backup transmitter must be activated by an automatic station guardian (failure sensing and failover switching) if the primary transmitter output falls to 50 percent of normal in an unplanned manner;

    - A pair of transmitters at a command control site, each connected to the station guardian, constitutes a system.

- When the launch vehicle airborne FTSs are active and ordnance is electrically connected, a command system must be radiating at the proper frequency to "capture" the receivers;

- During those periods when the FTS receiver is on, no UHF commands will be radiated in support of another operation unless there is at least a 4 MHz frequency separation.

The configuration of the command transmitter system may vary from launch to launch. The Command Transmitter Controller (CTC) determines the required configuration from the mission documentation and from instructions received from the MFCO. He ensures that all assigned command transmitter sites and telemetry monitoring stations are briefed on the required configuration and support.

The CTC sets up and checks out the command transmitter network, performs readiness checks, open loop checks, and the real-time phase in accordance with current operational procedures and specified Operation Directives (OD's). The supporting frequency monitoring sites set up, check out, and operate the monitoring equipment in accordance with current site operational procedures.

In its' current configuration the CCS is capable of supporting high-alphabit receivers.

2.4.6.6 Central Control Processing System (CCPS)

The CCPS is a multiple microprocessor-based system designed to provide operational support with at least one system failure. Its primary purpose is to communicate with the command control transmitter (CCT) sites (see Section 1, par.. 1.2.2.1).

2.4.6.7 Launch Operations

Preflight, countdown, and inflight launch vehicle operations are as follows.

2.4.6.7.1 Preflight Operations

During preflight operations, checkout of the command control system is completed by L-45 minutes. When these checks are completed, the Range Control Officer (RCO) confirms to the MFCO that the ground portion of the flight termination system is fully mission capable. The MFCO then assumes full control of all command control systems. After the MFCO assumes control of the systems, the Flight Safety Project Officer (FSPO) will not allow the flight termination receivers to be turned on or off, and the RCO will not allow functions to be transmitted, without the specific approval of the MFCO. In case of misfire, hangfire, or mission scrubs, the receivers are turned off in accordance with the appropriate checklist.

The MFCO will not authorize launch until the FSPO confirms that the flight termination system is functioning properly. Proper operation of the flight termination system, as verified to and confirmed by the FSPO, includes the following:

- The command control system supporting the launch is checked out and is fully operational;
- The airborne flight termination system is checked out and is fully operational;
- All displays associated with the flight termination system and command control system are functioning properly at the MFCO console positions.

The Operations Safety Manager (OSM) and/or the Operations Safety Technician (OST) are responsible for the following preflight action item requirements.

- At the time specified in the countdown/pre-count, the OSMs must be on station at the Operations Safety Console in the blockhouse/Launch Control Center and at the launch area;
- The OSM controls all warning devices provided to indicate caution and danger periods;
- The OSM declares caution and danger periods at the times such action becomes necessary in the interest of safety;
- At a mutually agreed upon point in the countdown, the OSM sends a green light signal to the MFCO to indicate that the Flight Caution Area is clear;

- The OSM initiates HOLDFIRE when safety constraints or emergency situations dictate.

In addition, the Launch Disaster Control Group (LDCG) controls access to all land-based hazardous areas during the countdown. Area status is reported to the MFCO by the LDCG team chief.

2.4.6.7.2 Countdown Operations

Three separate documents are published to govern launch and dress rehearsal activities - Launch Countdown, Phase 1, details the work required, step-by-step, to prepare the vehicle from the start of the countdown at T-25.5 hours (exact time may be vehicle dependant), to the final ‘pad clear’ at about T-4 hours. Launch Countdown, Phase 2, is the steps to be performed from the launch van, or by the range for the final hours of countdown through launch. The Launch Commit Criteria (LCC) is employed throughout the countdown to identify the allowable criteria limitations for weather, launch vehicle, or spacecraft systems. All three documents are coordinated with, reviewed by, and approved by spacecraft and launch vehicle engineering, vehicle operations, range operations, and Range Safety.

The personnel most involved in decision making during launch countdown include the following (NOTE: EWR 127-1 requires all personnel who accomplish prelaunch functions that require a high degree of concentration to have at least eight hours rest before a maximum 12 hour shift):

<u>Range Personnel</u>:

- Senior Mission Flight Control Officer (SMFCO);
- Mission Flight Control Officer (MFCO);
- Range Operations Commander (ROC);
- Range Control Officer (RCO);
- Launch Weather Officer (LWO);
- Flight Safety Project Officer (FSPO);
- Flight Operations Safety Manager (FOSM).

<u>Commercial Launch Operator Personnel</u>:

- Operator Launch Director (LD);
- Assistant Launch Director (ALD);
- Telemetry Systems Observer (TSO).

Payload Personnel:

- Payload Operator (PLO).

The responsibilities of each during countdown operations are as follows:

SMFCO - The SMFCO is directly responsible to the 30 SW Commander for the safe conduct of a launch during countdown and flight operations. He manages the mission flight control team during launch phase operations, maintains an overall view of range safety and vehicle prelaunch status, and directs the MFCO in critical safety decisions including countdown holds and flight termination.

MFCO - The MFCO is the safety focal point during all vehicle flight operations. He is responsible for controlling and coordinating the missile flight control portion of the countdown, and directs the actions of the mission flight control team. He is also responsible for making an overall launch hazard assessment, ensuring the range is clear of any traffic (i.e., trains, boats, planes, people); interfacing with the operations controller of the railroad monitor systems, ship radar, and airplane radar. He determines safety readiness to support the launch, monitors checkout procedures on the flight termination system, and conducts destruct systems tests. With the SMFCOs concurrence, he provides the safety readiness GO/NO-GO (final clear to launch) decision to the ROC. During the launch the MFCO makes real time flight termination decisions.

ROC - The ROC is the senior range representative for launch operations. The ROC serves as the interface between the launch agency and the range, and manages, directs, and controls range resources to ensure all range instrumentation is capable and ready to support launch operations. He is responsible for range support during the generation and launch phase of operations, including range instrumentation support, contingency support requirements, aircraft/seacraft support, and support by off-range assets. He certifies range readiness and provides the launching agency the final overall range GO/NO-GO recommendation.

RCO - The RCO is responsible for the management of all operational range instrumentation. He directs all range system interfaces with commercial launch operator systems and coordinates with range system controllers to ensure mission capable support during range operations. He reports status and GO/NO-GO recommendations to the ROC.

FSPO - The FSPO is responsible for all flight safety hardware on the launch vehicles. This includes the command destruct, automatic destruct and tracking systems. ration of the FTS.

The FSPO's launch countdown responsibilities include reviewing final systems test data, resolving real-time anomalies and certifying that airborne safety systems are GO for launch. The FSPO resides at a console position at the Range Users control facility and has access to FTS and tracking data. The FSPO provides the status of the airborne safety system to the MFCO. Therefore, when the MFCO gives a safety "GO", it should be assumed by the Range User that the FSPO has given his GO.

In addition, the FSPO is responsible for prelaunch activities which ensure the reliability of the airborne safety system. These efforts include airborne hardware develop, design, test and failure resolution

<u>OSM</u> - The OSM is responsible for site safety at the launch complex and reports site status as appropriate. OSM's have the ability to control site aural/visual warning devices and pad video. The OSM assures that the pad is clear for launch via video monitors and is assisted by the Operations Safety Technician who participates and monitors the vehicle arming operations. The OSM is responsible for all safety aspects of the launch complex, including pad clearing and re-entry.

<u>LWO</u> - The LWO is responsible for providing the latest weather information to the launch team. He is available for weather briefings at any time during countdown.

<u>LD</u> - The LD is the range user’s single point-of-command authority overseeing the launch team functions and responsibilities. He has the authority to stop the countdown at any point in the process, and is responsible for issuing final launch authorization. He ensures overall control of the countdown, maintains team discipline, and provides coordinating direction to the launch team during emergencies/contingencies, scrubs/recycles, and post-launch activities. Has final signature approval of all changes to the launch countdown procedure. He has authority over all testing activities, and works with Range Safety and the commercial Launch operator system safety engineer to ensure safety during launch/test activities.

<u>ALD</u> - The ALD assists the LD in coordinating the activities in the Launch Control Center during launch countdown. He is capable of performing the functions and responsibilities of the LD should the need arise.

<u>TSO</u> - The Telemetry Systems Observer sits at the Telemetry Display System Console. He observes the bar charts, analog display channels, and telemetry data, plus various status messages. Specific telemetry displays observed include vehicle chamber pressure, roll, pitch, and yaw, and FTS

status. Database parameters can be selected for each channel to illustrate out-of-tolerance conditions by a change of color or flashing conditions. The TSO is a member of the Missile Flight Control Section (SEO) or occasionally the SEY Section.

PLD1 - PLD1 is the payload manager who monitors the payload telemetry prior to launch to ensure the payload is ready to launch. He must rely on upper management and the Customer (either payload or commercial launch operator) for decision to approve readiness of the payload. Once approval is received, a GO/NO-GO decision is relayed to the LD.

PLD2 - PLD2 is the assistant payload manager.

During terminal countdown, there are really only two decision makers, the MFCO and the LD. The Launch Control Center contains the essential personnel to support the LD in his decision making process from the vehicle point of view (including the payload) and does not have to rely on any other management direction. The MFCO, with the support of the FSPO and OSM, will enable the flight termination system and give the GO/NO-GO decision to the RCO to pass to the LD when all sites have reported as ready, based on the range criteria being met for a safe launch. It is then the responsibility of the LD to initiate launch.

After T-0, however, the responsibility shifts solely to the MFCO who is tracking the vehicle to determine the vehicle flight path with respect to range limit lines, which are predetermined and specific to the vehicle's accelerations. He has the sole responsibility to terminate flight if flight safety criteria are violated.

To ensure constant communication between the MFCO and the LD, the following means of contact are normally in place:

- Voice Direct Lines (VDL), a primary and backup;
- Countdown Net (C/D), a primary and backup;
- Status and Alert Lights installed at the consoles to indicate the GO/NO GO decisions that have been made.

After launch, the range user plays no role in the flight other than having the ability to observe telemetry data. Non-Safety personnel are not linked to the safety net in order to eliminate any potential distractions that may occur during dialogue between safety personnel as they monitor the vehicle.

2.4.6.7.3 Inflight Operations

The MFCO exercises operational control of the launch vehicle throughout powered flight using flight radar data (skin track and transponder augmented track), flight vehicle guidance TLM data, long range optics video, and ground observation data (back azimuth and program positions), to determine the vehicle flight path with respect to impact limit lines.

After vehicle ignition, the MFCO receives an “ignition” and “lift-off” call from the Forward Observers, Program and Back Azimuth, followed by a status report from the Telemetry Systems Observer. The Instantaneous Impact Predictor and the Real-Time Debris Footprint are the first display items to generate history and appear to move. All MFCO support position operators report on a common voice net with a continuing dialogue as flight proceeds downrange and display information is continually updated. The Forward Observers report any abnormalities and staging events, if observed. The TM reports vehicle performance and events as displayed on the Range Safety Telemetry Display System. Any malfunctions or trajectory divergences observed by the MFCO will be confirmed by the Senior MFCO.

The Command Transmitter Controller (CTC) monitors command transmitter switching for the flight termination system as the vehicle proceeds downrange. The CTC interfaces directly with the MFCO, and ensures that the MFCO has the capability to send flight termination command signals if required. He also ensures that the required carrier and check channel are being transmitted.

The current command control system is switched at preselected times; the switch being made manually by the CTC. The switching times are published in the RSOR. Indicators on the MFCO and CTC consoles show which command transmitter is radiating. Normally, site CT-1, CT-2, or CT-3 is used initially with a switch to site CT-6 being made for commercial polar launch orbits at approximately 50 seconds. CT-6 should not radiate while the local transmitter is radiating, therefore, there is a small time delay associated with the command switch. During this time delay, the airborne receivers are not captured by any WR command transmitters. The Automatic Gain Control (AGC) level of the airborne receivers is used as the primary parameter for confirming transmitter switching. After the switch, the MFCO confirms from TM that the AGCs are operating properly. If AGCs are not satisfactory, then a switch to another command transmitter site may be called for. While the RSOR calls for a certain switch time, the MFCO can, and will, call for any site throughout the flight profile. Experience dictates that vehicle exhaust plume attenuation begins at the local sites at about the published switch times.

MFCO operations at the WR use only one set of FTS switches for all launch support. If a problem exists at the MFCO console, the procedure is to bring up a redundant standby system or use the direct contact with the site to have the functions sent by the site operator. The capability to use dual switches for all launch vehicles is being engineered at the present time.

2.4.7 Personnel Training and Certification

This section addresses the training and certification of personnel who are critical to the Range Safety function.

2.4.7.1 Mission Flight Control Officer (MFCO)

The MFCO is a member of the Mission Flight Control Section of the 30 SW Safety Office. However, during launch operations, the MFCO is the official representative of the Wing Commander and is responsible for taking all reasonable precautions to minimize the risk to life and property during launch vehicle flight.

Initially, each potential MFCO undergoes supervised training and checkout in assigned flight control launch support positions. These positions include Forward Observer and Telemetry. The trainee observes, participates, and is formally checked out in each position during actual launches. In addition, he is trained as a primary MFCO in simulated launch exercises where failures in instrumentation and communications are simulated. These exercises are not only designed to familiarize the trainee with potential problems and solutions, but are also used to gauge his judgment, reaction time, and stability under stress.

The trainee becomes familiar with the range, its instrumentation, facilities, and personnel through conducted tours and briefings. He is assigned a program and becomes familiar with all aspects of its functions, systems, and operational characteristics. The trainee is also assigned an alternate program and replaces the primary MFCO for that program when necessary.

The trainee is checked out as a primary MFCO only after satisfactorily completing all initial phases of the training program. Final checkout consists of manning the MFCO console during an actual launch and being responsible for terminating flight if established safety criteria are violated. The MFCO continues to increase in experience and knowledge by assisting other primary MFCOs during their launches and training exercises, and by undergoing recurring MFCO training as necessary.

After the MFCO trainee has successfully completed training, the trainee and the Training Officer (TO) meet with the Section Chief to review the trainee's performance. The Section Chief will, after conducting this review, recommend to the Wing Commander that the trainee be certified as a MFCO, or advise the TO that additional training is required.

2.4.7.2 Senior MFCO Training (SMFCO)

The Senior MFCO training phase begins when the MFCO has achieved the prerequisites and demonstrated the skills specified above, and has normally been a certified MFCO for at least one year. Additionally, the MFCO must be certified on a minimum of one ballistic and one space vehicle. MFCOs must show a thorough understanding of the capabilities and limitations of each instrumentation system. They must recognize the inter-relationship between sensors and know what combinations for particular missiles constitute acceptable/unacceptable flight safety support. The SMFCO trainee must participate in flight simulations involving indeterminate or nonexistent data. SMFCOs are evaluated by the TO during the simulations and on one checkout flight operation. After successfully completing an oral examination given by the TO and the Chief of Safety, the SMFCO trainee may be recommended for certification by the 30 SW Commander.

2.4.7.3 Flight Safety Analyst (FSA)

The Flight Analysis Section (SEY) training requirements for a new Flight Safety Analyst (FSA) are general in nature and cover a broad range of various disciplines involved in flight safety. New flight analysts coming into the Flight Analysis Section are subject to a formal training program. All personnel are degreed engineers, mathematicians or scientific analysts. On-the-job training is the primary method used for flight analysis personnel. The trainee is assigned to a support role for space launch vehicle programs and receives guidance and instructions from a senior analyst who reviews and approves the trainee's work. The trainee performs analyses of vehicle performance, failure modes, spent stage impact debris, impact limit lines, destruct lines, and many other safety-related issues. These analyses help to assure that the proposed space vehicle missions are being conducted in a manner consistent with flight safety criteria.

- Training Timetable - The length of time required to complete the Flight Safety Analyst training varies, depending on the trainee's capabilities and previous experience as well as the launch schedule and availability of training supervisors. However, approximately one year is required for the trainee to complete the program and become fully qualified;

- Certification - The certification process for FSAs concludes with the trainee's designation as Senior FSA. The FSA trainee must demonstrate to SEY management the knowledge and skills sufficient to conduct flight safety support of a launch, as well as complete the specified training requirements prior to being certified.

2.4.7.4 System Safety Training

All personnel in the Systems Safety Section (SES) are subject to training requirements dictated by their position descriptions. Training is accomplished in a variety of different ways, ranging from individual self-study courses and technical seminars and symposiums to diverse college level courses presented by many universities and colleges across the country. Section resources play a significant role in the overall training program.

The initial training phase covers approximately one year for a safety engineer entering at the GS-07 level. Training is provided by designated subject matter specialists (within or outside of the System Safety Section) or at government training facilities. The trainee is required to attend and satisfactorily complete formal academic programs at the undergraduate and/or graduate level. One such program is the System Safety Course offered by the University of Southern California. On-the-job training is also a very important part of the training process. The trainee is exposed to areas that include the following: pad safety, facilities, governing safety directives, explosives safety, flight termination systems, nuclear safety, solid/liquid propellants, toxic hazards, hypergolics, launch vehicles, downrange stations, industrial safety, ground safety, and payload safety.

2.4.7.5 Flight Safety Project Officer (FSPO)

The FSPO's are assigned to the Engineering Support Section of the 30th Space Wing Safety Office and are usually civil service employees at the GS-13 level. They are responsible for the airborne safety system from concept definition, development, test and operational support. The FSPO training and certification program, for each employee, is formally documented in the FSPO training manual. The objective is to provide personnel who can certify systems which can meet stringent reliability requirements. There are three types of formal FSPO certifications:

- Program Manager Certification;
- Operations Certification;
- Recurring and proficiency training.

Program Manager Certification: This Certification enables the FSPO to work all aspects of airborne safety system design, development, test and anomaly resolution which lead up to launch. Each trainee obtains individual areas of expertise and when certified in a technical specialty, can work that technology on any program. Each FSPO is assigned a minimum of three programs, for which he/she is responsible. A FSPO may utilize the expertise of another FSPO who is certified in a specific technology. Each individual is expected to ensure public safety reliability requirements are met while minimizing cost and schedule impacts to the Range Users.

Operational Certification: Each FSPO first receives a generic operational certification. This requires the FSPO to work a variety of programs and successfully support these programs with no senior FSPO intervention. Typically, 10 launches are used to develop the generic operational certification. Certification for individual programs is achieved by autonomously supporting two launches of that vehicle type. During these certification operations, a certified FSPO will be in attendance to back-up the trainee should assistance be necessary. Following successful completion of all prerequisites, the trainee receives a certification which is documented in the FSPO training manual.

Recurring and proficiency training: The FSPO who was assigned during the design, testing, and integration of a new-to-the-range system is the defacto certified FSPO for that system. Recurring and proficiency training is continuous for all personnel. Each individual is expected to exercise maximum initiative to complete training items in the minimum time, consistent with launch opportunities and training priorities as established by the SEO and SES Sections.

2.4.7.6 Other Training

In addition to the above training requirements, there are a number of other critical areas which also must meet stringent training criteria.

2.4.7.6.1 The Operations Safety Manager (OSM)

The OSM must undergo a rigid training program. He is the FCOs on-scene representative, verifying that all aspects of the destruct system tasks have been done in accordance with approved procedures. Similar training/certification requirements exist for instrumentation operators, radar personnel, the command destruct transmitter technicians, and a number of others.

2.4.7.6.2 Console Controllers

The Missile Flight Control Center contains the following control consoles: MFCO, Real-Time Data Controller (RTDC), Acquisition Data System (ADS), and Command Transmitter Controller (CTC). Except for the MFCO console, these consoles are manned by the Technical Services Contractor controllers who are required to complete a four phase training program.

- Phase I is familiarization - This includes preparation of Level III documentation in the UDS format, training on range procedures, and range facility orientation. Mission support begins in Phase II;

- Phase II - A minimum of five non-flight operations or simulations are used to show what is done and to give the employee his first experience in conducting an operation. All support is done under the direct supervision of a certified controller. Phase II continues until the employee, trainer, and supervisor agree that he is ready for Phase III, flight support;

- Phase III - Normally, during this phase, several missions are worked. The first one is observed and then the countdown is performed by the trainee on the next mission. The trainee must satisfactorily support additional operations under the direct observation of a trainer before he is certified. Once certified, the employee is assigned to console positions on his own;

- Phase IV - Training does not end with certification. Periodic site orientation visits continue as do recurring evaluations. Action is initiated as required to ensure that all of the controllers remain qualified and current on active programs, procedures and range capabilities.

The time required for full certification varies depending on the position, frequency of launch operations, and the WR range experience of the individual. Past experience has shown that the certification process requires from three months to over a year.

2.4.8 Commercial Launch Operator Responsibilities and Requirements

The commercial launch operators have the responsibility to provide systems, equipment, and facilities and to conduct their operations in a safe manner that complies with and implements those portions of the WR safety program that are applicable to their mission. This is accomplished by joint Range Safety/commercial launch operator review and approval of components, systems, and subsystems at design reviews; the approval of hazardous operations and their associated operational procedures; the acceptance and qualification tests for critical systems, such as the FTS; the review and approval of quantity-distance siting for all support facilities and launch complexes; and the data required for flight plan approval.

In addition, the commercial launch operator is responsible for :

- Identification of Data Requirements. The commercial launch operator must identify data requirements in terms of precision, quality, format, quantity, and time and method of delivery;

- Radio Frequency Compatibility Tests. New commercial launch operator airborne instrumentation systems requiring WR data acquisition and processing must undergo radio frequency (RF) compatibility testing with the appropriate range acquisition system prior to flight;

- Mandatory Data Requirements. The commercial launch operator must identify data requirements as to “mandatory” (NO-GO), “required” or “desired”. In the event the requirements are mandatory, the 30 RANS will attempt to provide a backup source of instrumentation for data collection.

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